A330
TECHNICAL TRAINING MANUAL
MECHANICAL & AVIONICS COURSE - T1+T2 (LVL 2&3)
(RR Trent 700)
LANDING GEAR

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LANDING GEAR

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G9409341 - GAUT0T0

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW

MAIN LANDING GEAR (MLG)

Each Main Landing Gear (MLG), which retracts inboard into its wheel bay in the fuselage and the wing, includes these main parts:
- a side stay assembly,
- a MLG leg assembly,
- a bogie alignment pitch trimmer,
- a bogie beam assembly.

The MLG is hydraulically operated during the normal extension/retraction sequence.

The MLG leg includes a shortening mechanism, a bogie pitch trimmer and an oleo-pneumatic shock absorber. The shock absorber absorbs the taxi, TO and landing loads. The shock absorber is a capsule type that includes a sliding tube. It is an oleo-pneumatic unit that is installed in the main fitting.

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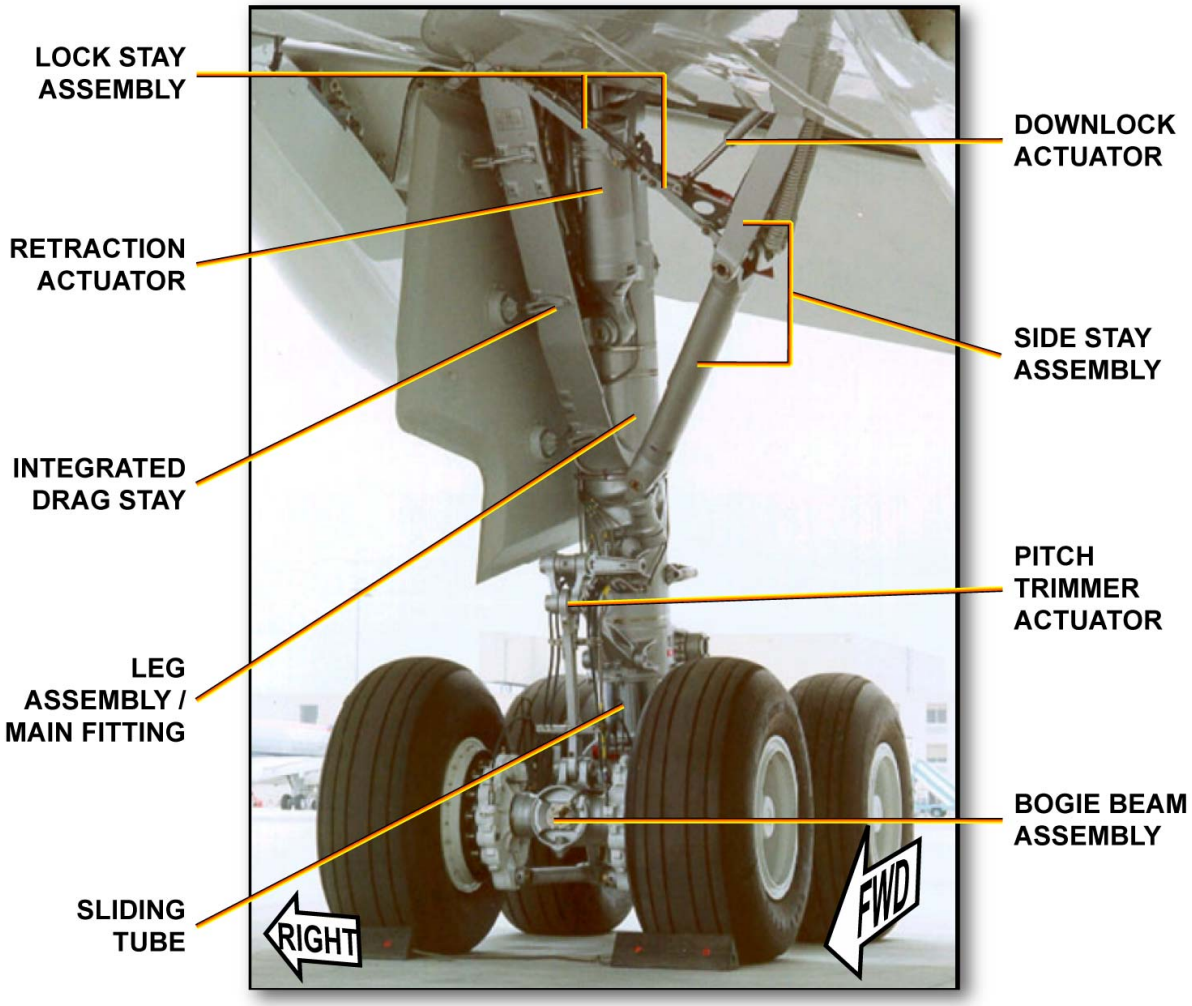

SYSTEM OVERVIEW - MAIN LANDING GEAR (MLG)

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

MLG SIDE STAY ASSEMBLY

A two-piece side stay assembly holds the MLG in the extended position. The lock stay is the mechanical down lock for the MLG. A lock stay keeps the side stay assembly stable in the locked down position. The lock stay is the mechanical down lock for the MLG. A ground lock pin has to be installed through the links of the lock stay, when they are in the over center position, to comply with safety precautions.

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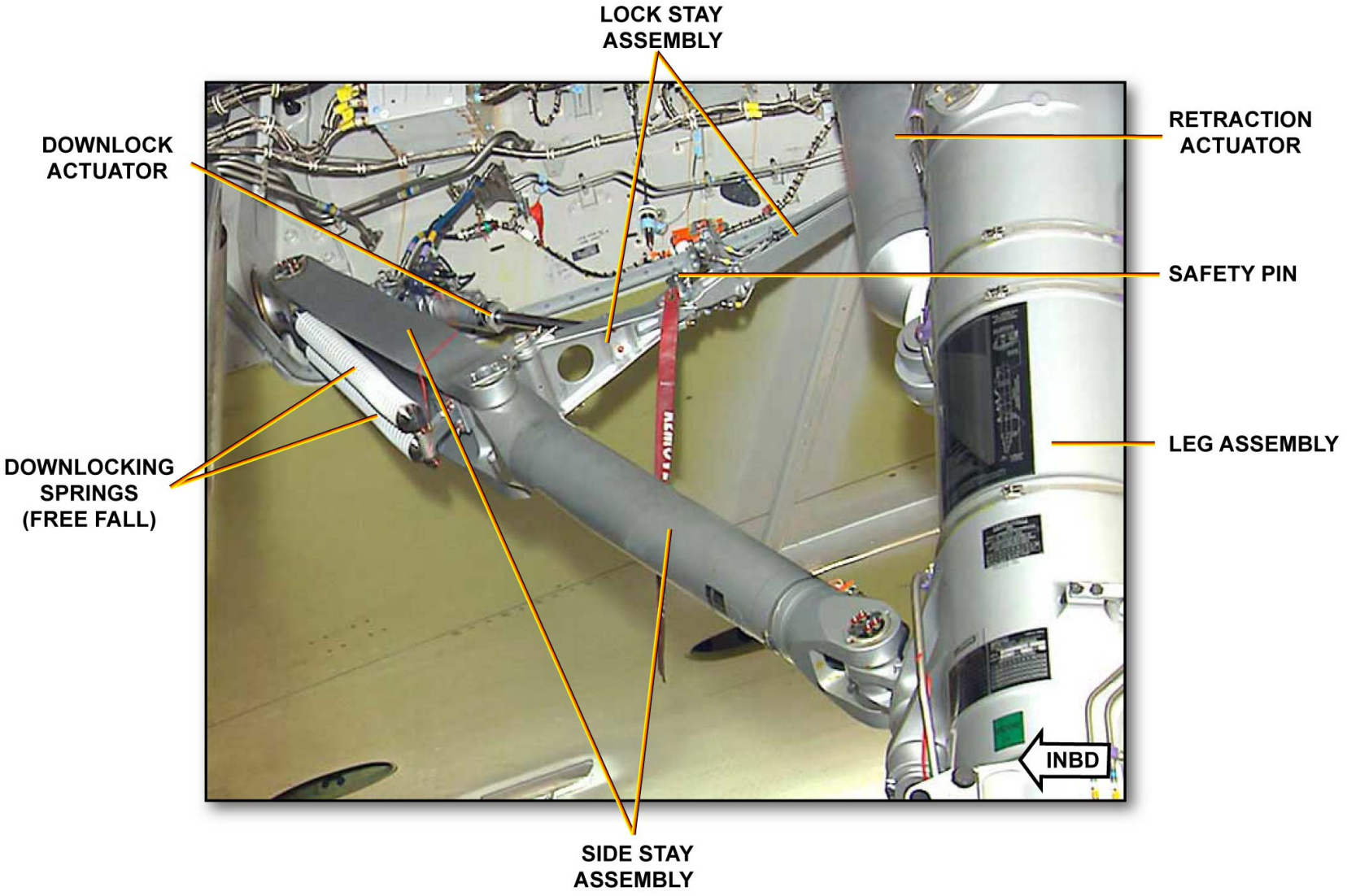

SYSTEM OVERVIEW - MLG SIDE STAY ASSEMBLY

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

MLG BOGIE ALIGNMENT PITCH TRIMMER

The pitch trimmer is installed between the main fitting and the upper links. A set of articulated links, two upper and one lower, connects the main fitting to the front of the bogie beam. The green hydraulic system continuously supplies pressure to the pitch trimmer, which maintains the required geometry of the links during the retraction sequence, TO, and landing phases.

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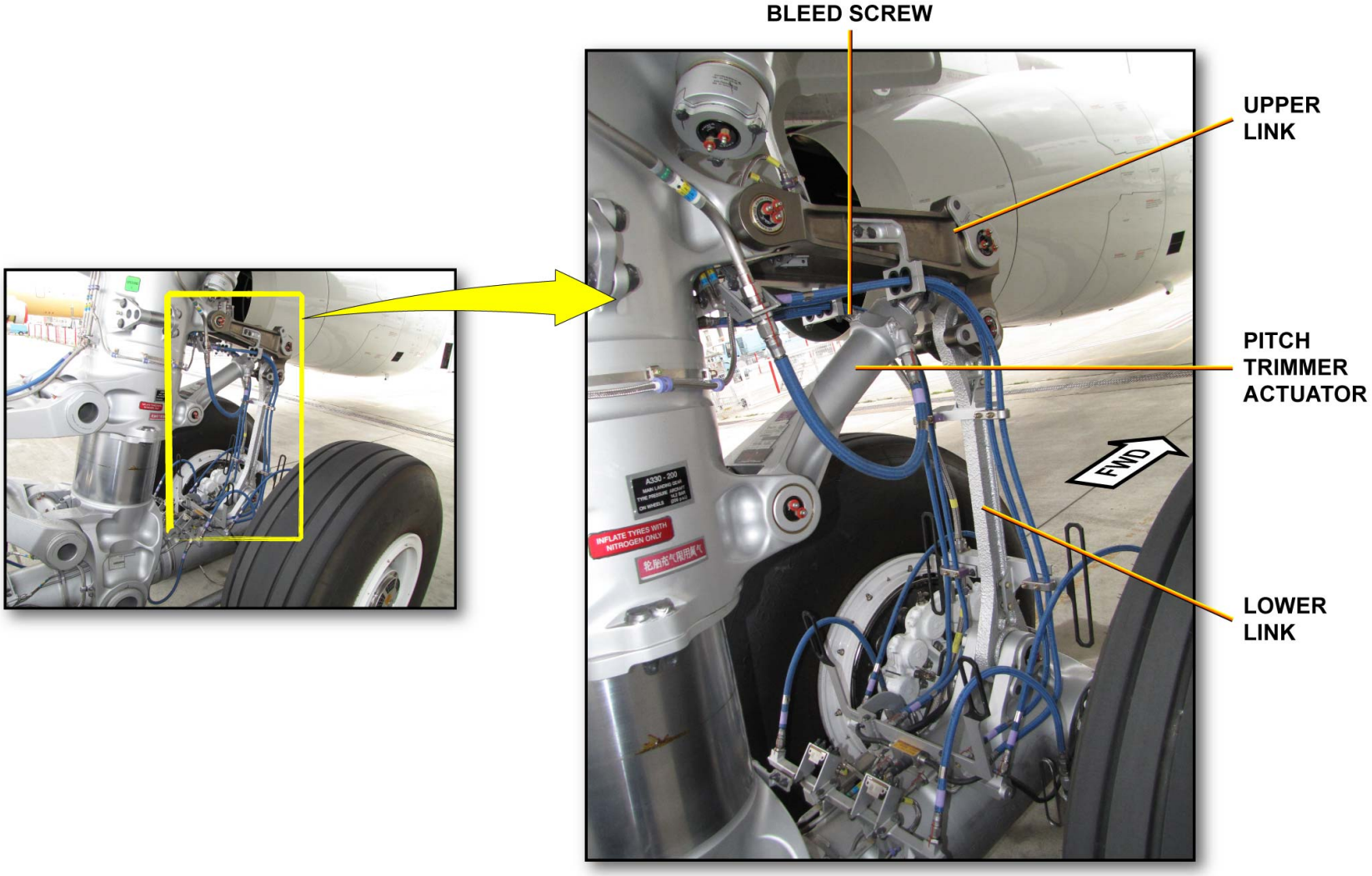

SYSTEM OVERVIEW - MLG BOGIE ALIGNMENT PITCH TRIMMER

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

MLG SHORTENING MECHANISM

During the retraction the shortening mechanism decreases the overall length of the MLG to permit the gears to go into the available space in the bays. The shortening mechanism includes a turnbuckle link connected on one end to the airframe wing and a system of mechanical links that is attached to the shock absorber. The MLG movement operates the shortening mechanism during retraction or extension.

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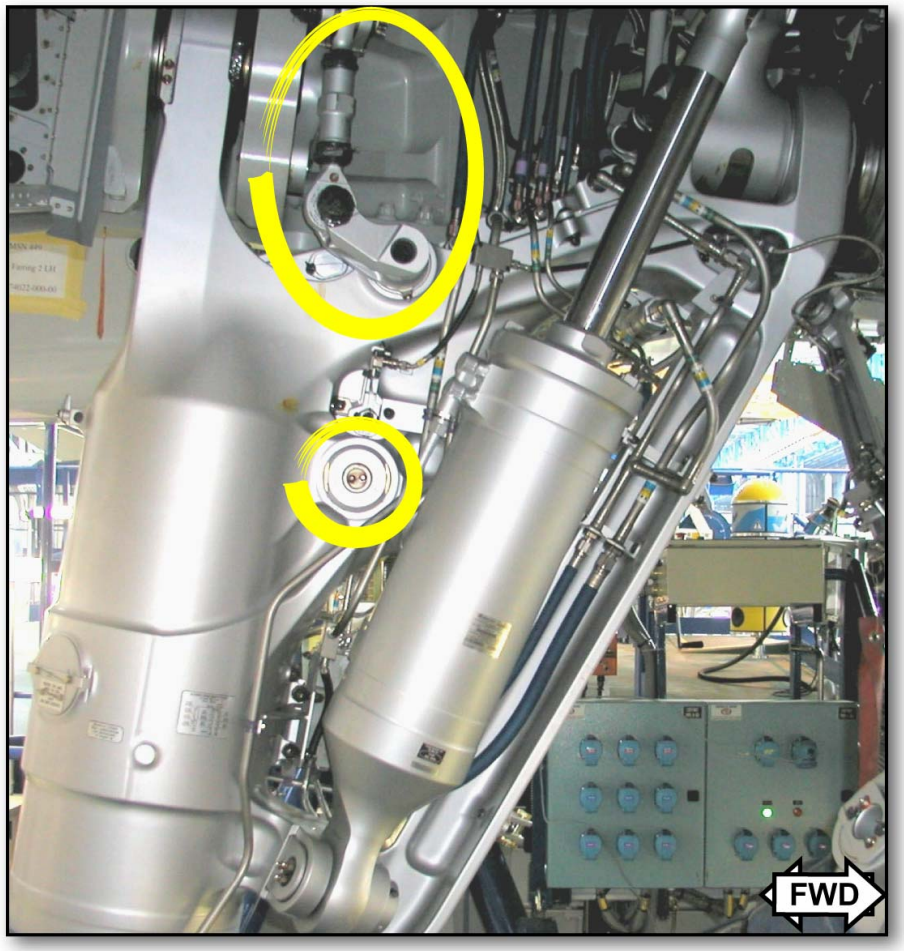

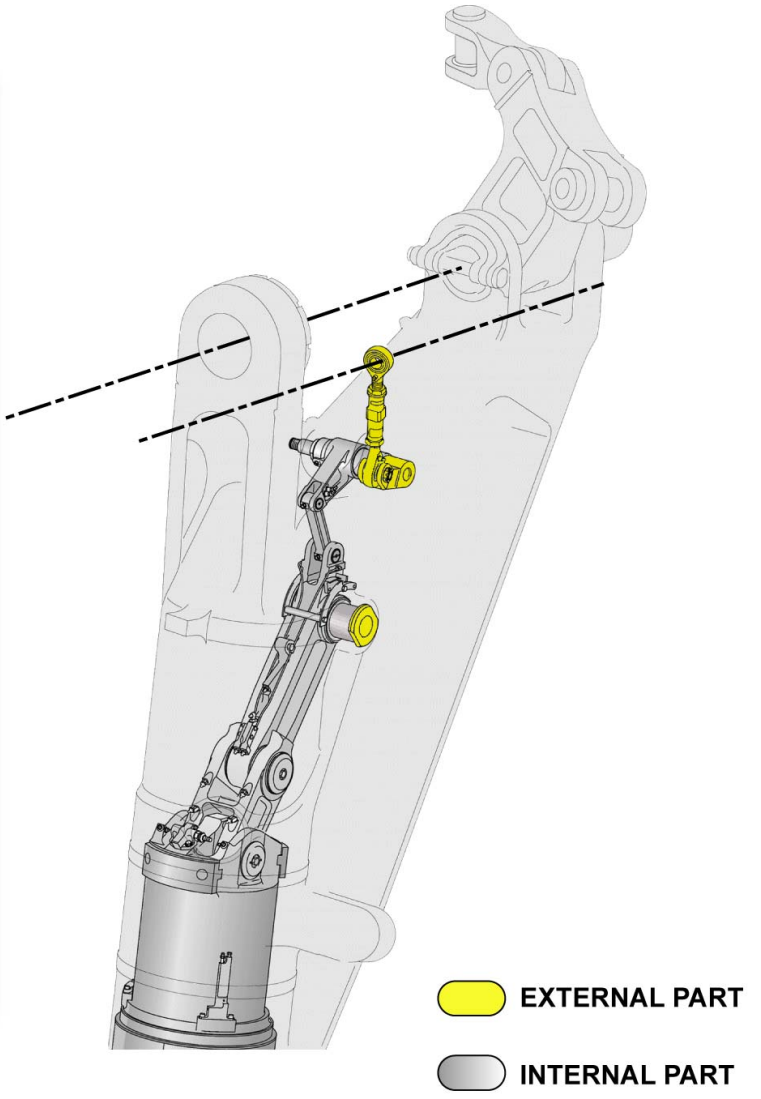

SYSTEM OVERVIEW - MLG SHORTENING MECHANISM

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

MLG DOORS

Three doors close each MLG bay. They follow the shape of the belly fairing and protect the equipment in the bay from the airflow during flight. The MLG doors are hydraulically operated. Each main door is hinged at the keel beam and closes outboard. The fairing door is attached to the MLG leg and operates with it. The hinged door is connected to the MLG leg through an adjustable rod. When the main gear operates, the rod operates to move the hinged door. A lock collar can be installed on each door actuator when the aircraft is on the ground to prevent closure.

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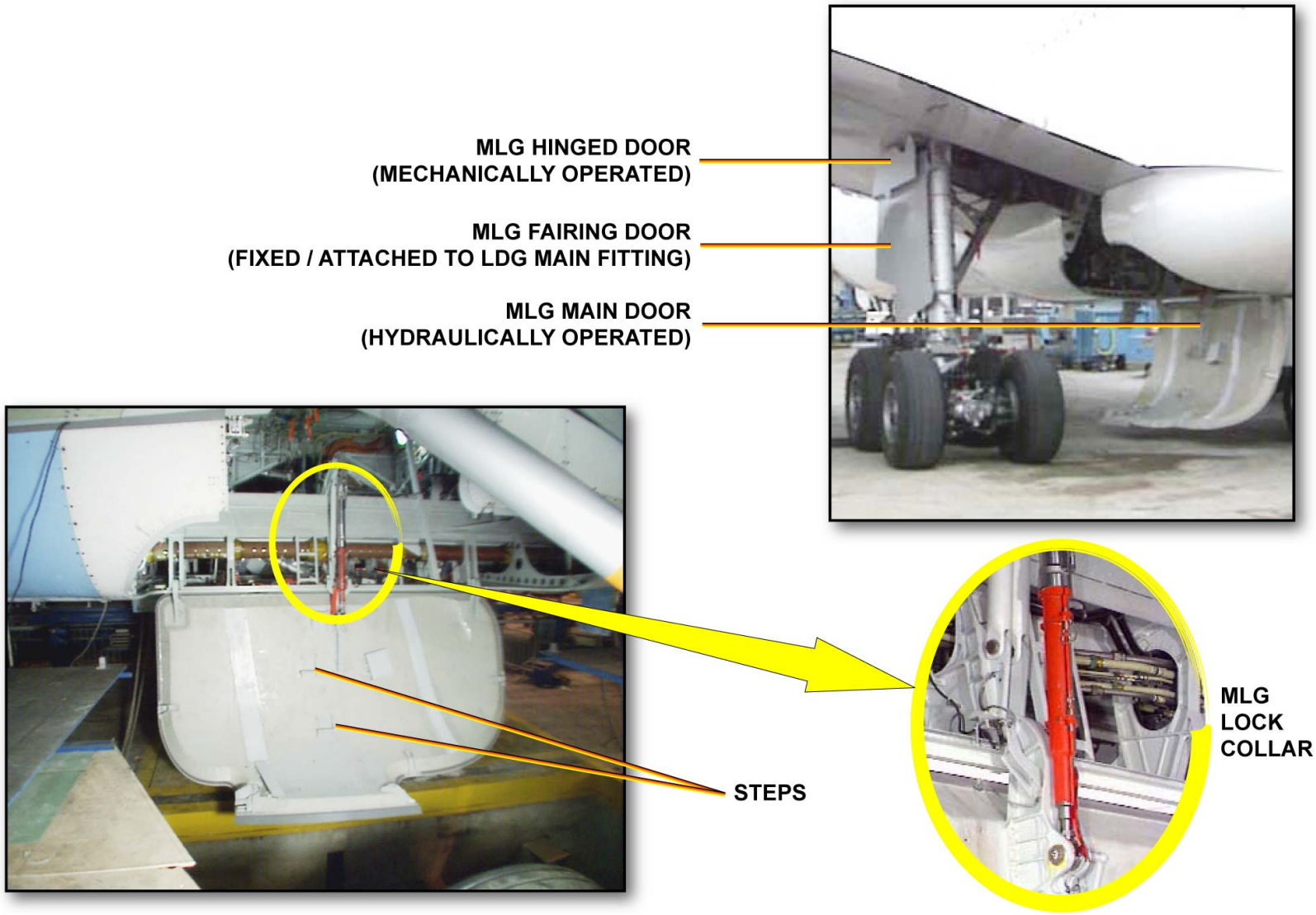

SYSTEM OVERVIEW - MLG DOORS

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

NOSE LANDING GEAR (NLG)

Each Nose Landing Gear (NLG), which retracts forward into the NLG bay, includes these main parts:
- a lock stay assembly,
- a NLG leg assembly,
- steering actuators.

The MLG is hydraulically operated during the normal extension/retraction sequence.
The L/G leg has a main fitting with a sliding tube assembly that includes the axle and a shock absorber with a wheel steering assembly.
The nose wheels are steered by twin, double acting hydraulic actuators, which pivot on attachments on the main fitting.

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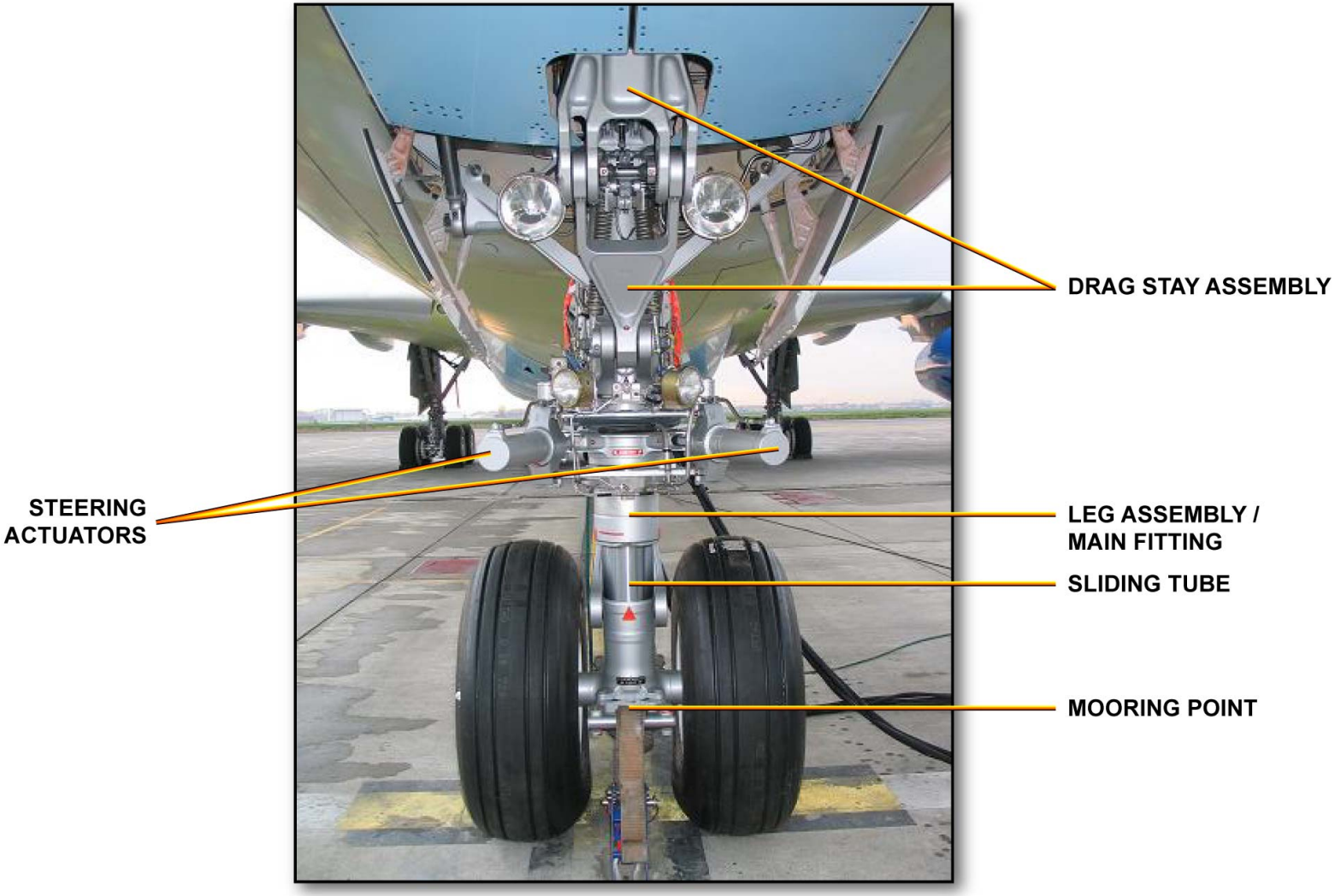

SYSTEM OVERVIEW - NOSE LANDING GEAR (NLG)

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

NLG LOCK STAY ASSEMBLY

The lock stay is installed between the main fitting and the center pivot point of the drag stay. It has an upper link and a lower link. The lock stay holds the drag stay in a straight configuration when the NLG is extended. A ground lock pin can be installed in the center pivot point of the lock stay when the NLG is down locked.

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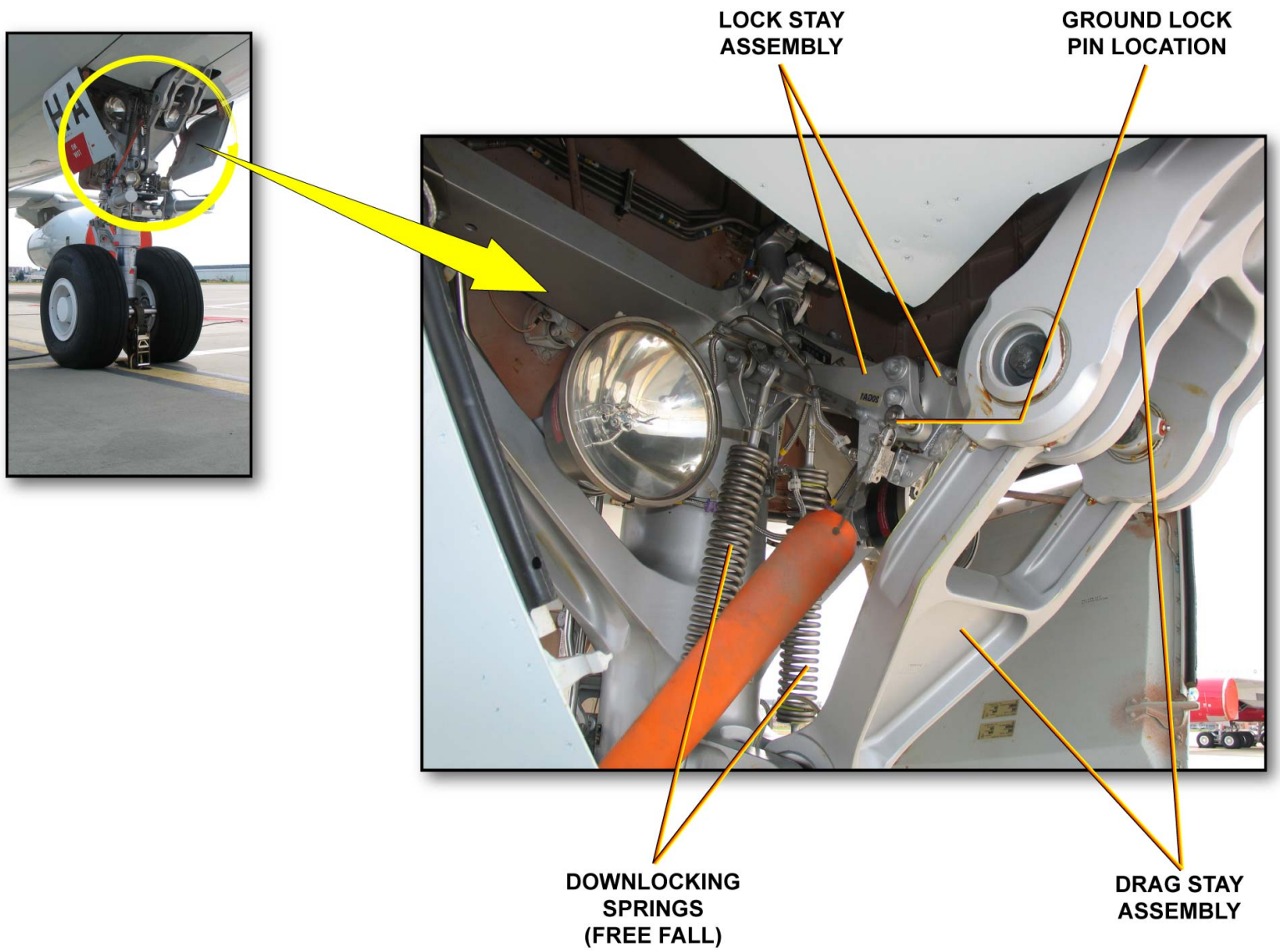

SYSTEM OVERVIEW - NLG LOCK STAY ASSEMBLY

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

NLG DOORS

A lock collar can be installed on each door actuator when the aircraft is on the ground to prevent closure. Four doors and a fixed fairing close the NLG bay. The two forward doors are hydraulically operated. Each door has hinges at the side of the NLG bay and closes inward at the front of the bay. The two aft doors and the fixed fairing are mechanically operated. Each aft door has hinges at its outer edge. Adjustable rods connect the rear doors to the NLG leg. The fixed fairing is installed at the rear of the NLG leg.

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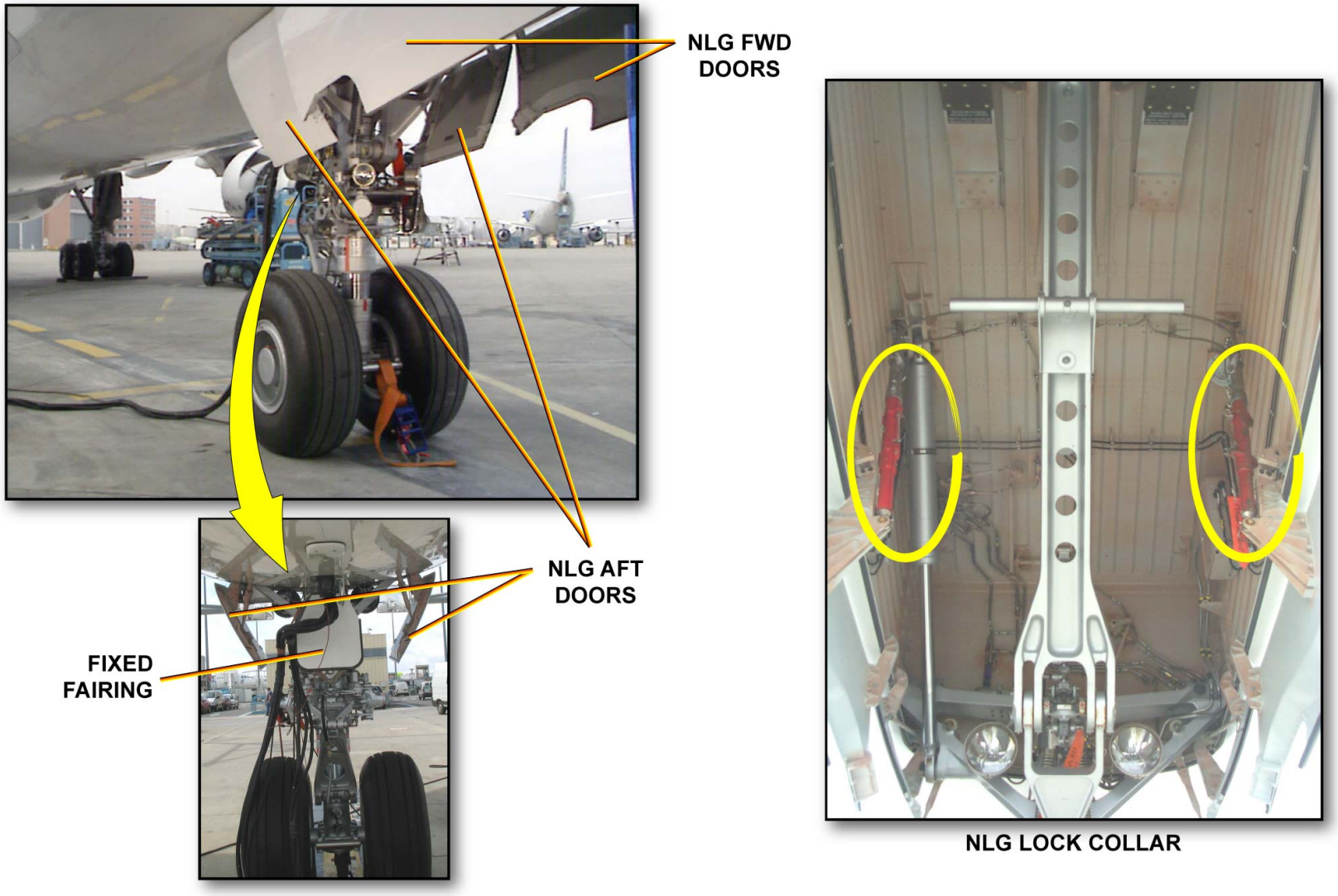

SYSTEM OVERVIEW - NLG DOORS

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

NORMAL BRAKING MANUAL MODE

In manual mode, the aircraft on ground, with the braking pedals operating, the related braking inputs are sent to the Braking and Steering Control Unit (BSCU), which energizes the normal selector valve to connect the green hydraulic power to the system. A pressure switch measures the HYDraulic pressure in the system and supplies the data to the BSCU. The automatic selector, operated by the hydraulic pressure, lets the green system supply the normal brakes and cuts the blue HYD pressure. When both hydraulic systems are available, by its internal design, the automatic selector gives priority to the green system. The servo valve, controlled by the BSCU, modulates the HYD pressure sent to the brakes according to the pedals demand and the Anti-Skid (A/SKID) protection. Wheel rotation speed and braking pressure values are fed back to the BSCU for braking and A/SKID computation. The BSCU sends data to the WHEEL page.

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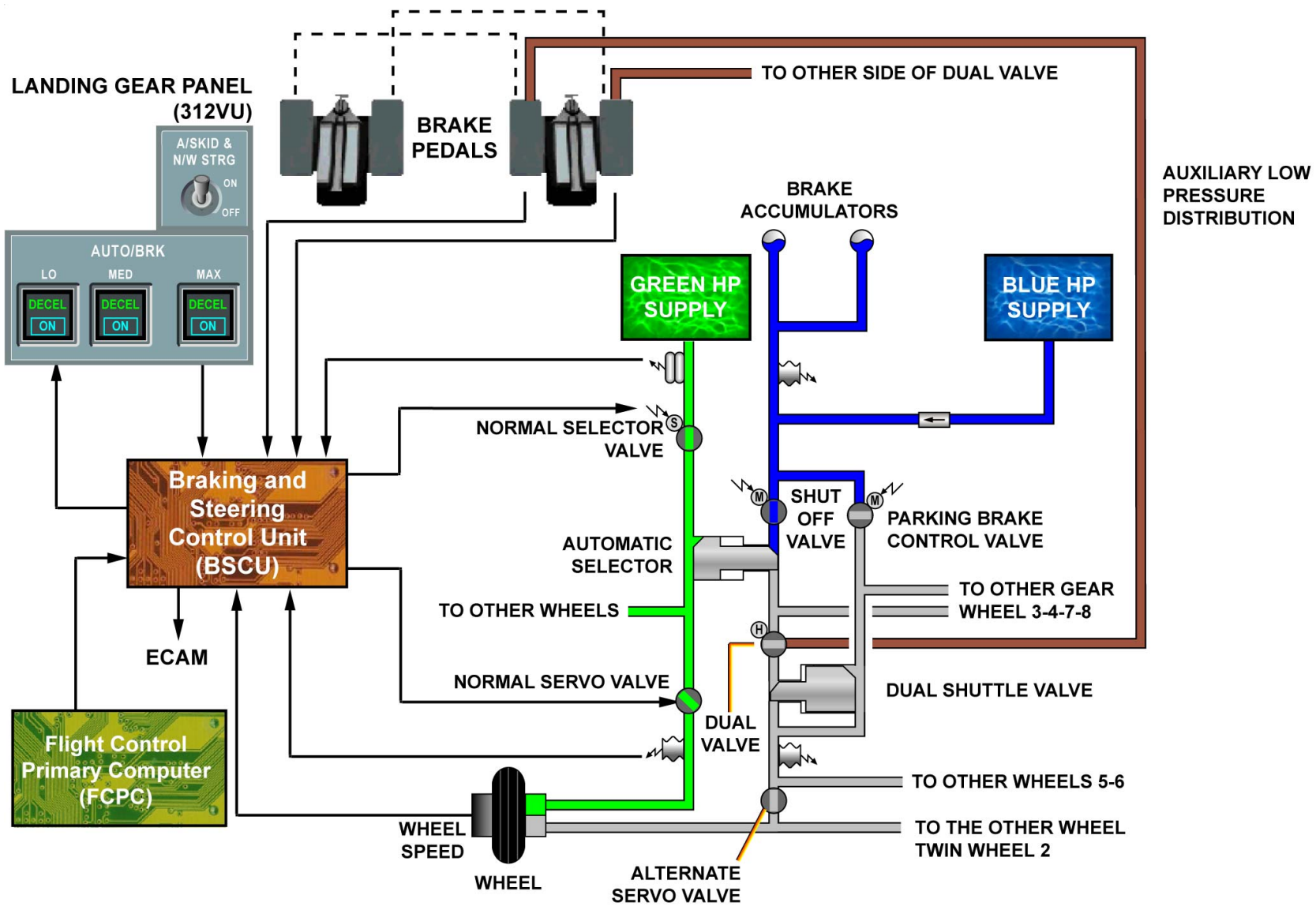

SYSTEM OVERVIEW - NORMAL BRAKING MANUAL MODE

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

ALTERNATE BRAKING

The alternate braking system is a hydro mechanical braking system. It is manually operated to decrease the speed of the aircraft when it moves on the ground. The alternate braking system automatically takes over if a failure occurs in the normal braking system or in case of green hydraulic system low pressure. It can operate with A/SKID or without A/SKID. The alternate braking system is controlled by the auxiliary low-pressure distribution and hydraulically operated by the blue hydraulic power.

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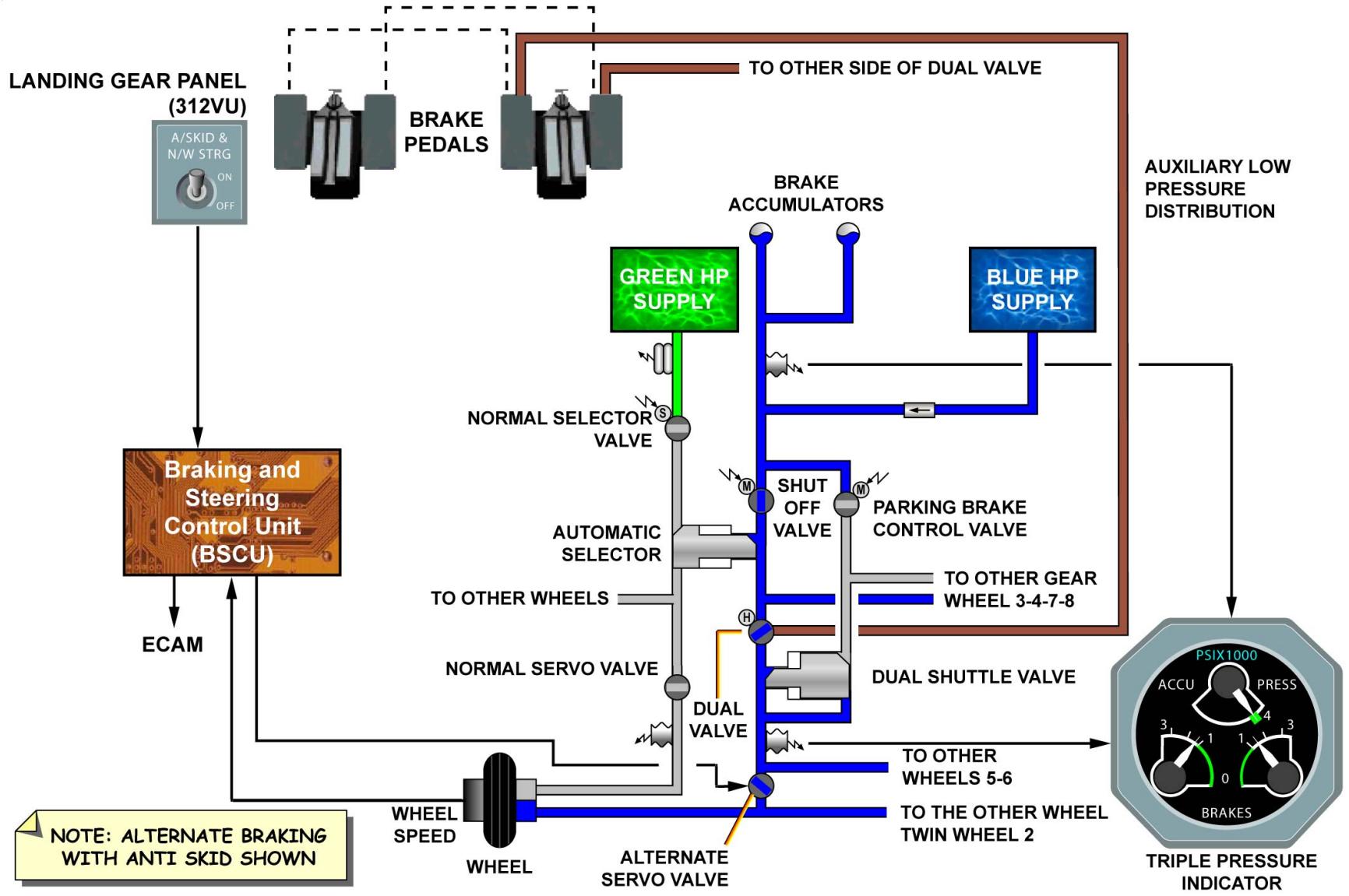

SYSTEM OVERVIEW - ALTERNATE BRAKING

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

PARKING/ULTIMATE EMERGENCY BRAKING

The parking/ultimate emergency braking system is an electro-hydraulic system. Its function is to prevent movement of the aircraft when it is parked. This system is electrically controlled and hydraulically operated by the blue hydraulic power or by the blue pressure brake accumulators. The parking/ultimate emergency braking system can also be used in an emergency braking mode to stop the aircraft when no other braking mode is available. When the PARKing BRaKe handle is set to ON, the parking brake control valve is activated and connects the blue pressure to the system. The dual shuttle valve, operated by the hydraulic pressure, connects the blue pressure to the fully opened servo valves and closes the supply downstream of the dual valve to isolate the brake pedals. The park brake control valve sends a signal to the BSCU to isolate the other braking systems. When the PARK BRK handle is set to OFF, the parking brake control valve cuts the blue pressure and the dual shuttle valve re-opens the hydraulic supply from the dual valve. The triple pressure indicator shows the available pressure from the brake accumulators. It also shows the pressure applied on the MLG brakes. This pressure is limited by the system to 2.580 psi. The accumulators have sufficient capacity to hold the brakes on for a minimum time of twelve hours.

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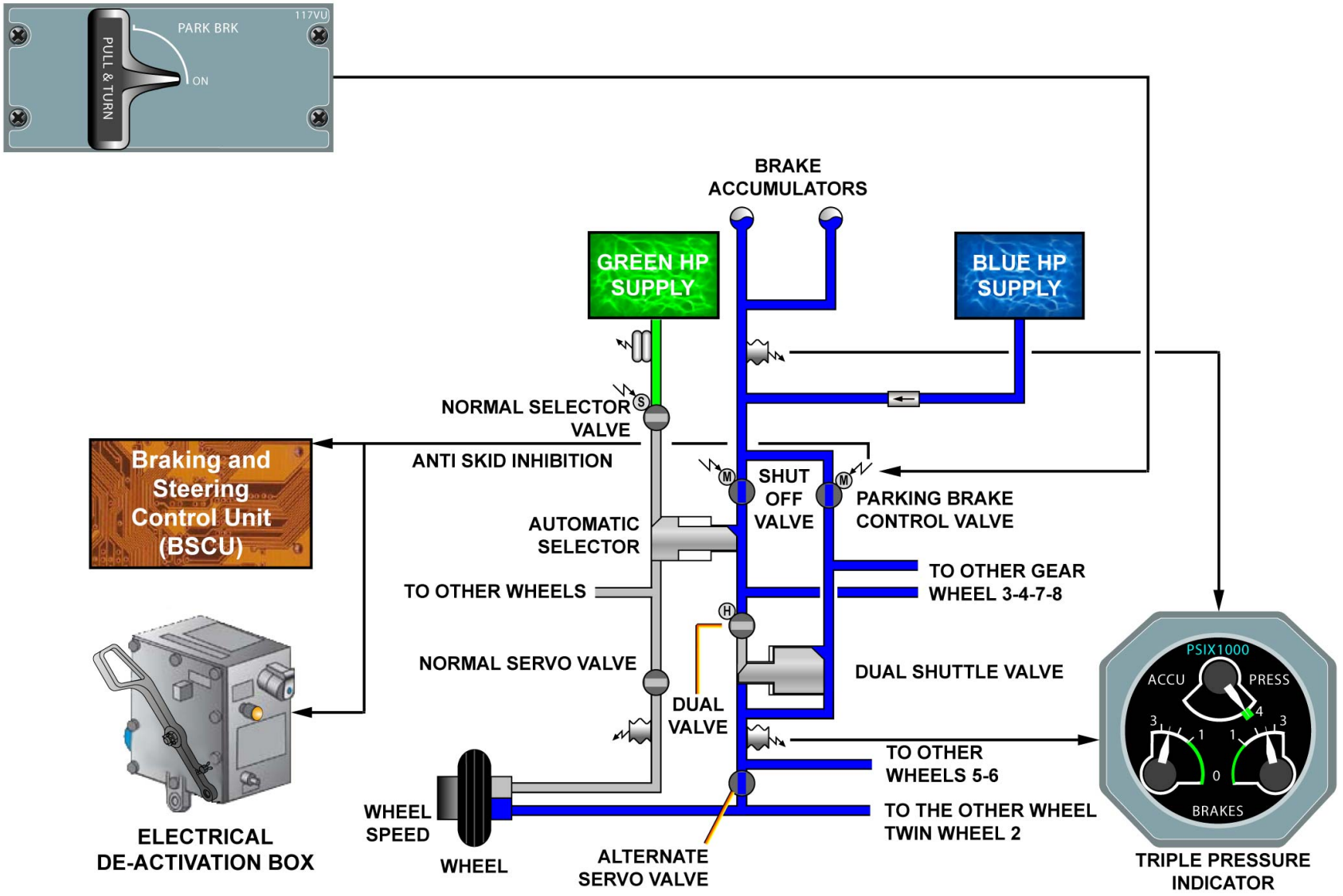

SYSTEM OVERVIEW - PARKING/ULTIMATE EMERGENCY BRAKING

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

SYSTEM OVERVIEW (continued)

SAFETY PRECAUTIONS

When working on the L/G system, you must obey all the AMM safety procedures. This will prevent injury to persons and/or damage to the aircraft. The main safety precautions relative to the L/G system are:
- make sure that all circuits are isolated during any maintenance task. Unwanted electrical or hydraulic power can be dangerous,
- make sure that the travel ranges of the L/G and doors are clear. Movement of the L/G and doors can cause injury and/or damage,
- make sure that the wheel chocks are in position and the L/G ground safety locks are installed. This prevents unwanted movement of the aircraft or L/G,
- let the brakes and the wheels become cool before going near the L/G. Do not apply a liquid or gas fire extinguisher directly on a hot wheel or brake unit. This could cause an explosion,
- deflate the tire before removing the wheel. This prevents a possible explosion,
- before removal or installation of a component, make sure that a man can hold it because some components are heavy. If one falls, it can cause injury to persons and damage to equipment,
- during L/G servicing, do not let high pressure gas get in contact with the skin. Gas bubbles in the blood can kill a person,
- during work near the wheel brakes, use safety glasses and a mask. Carbon brake dust can cause irritation to the eyes or lungs.

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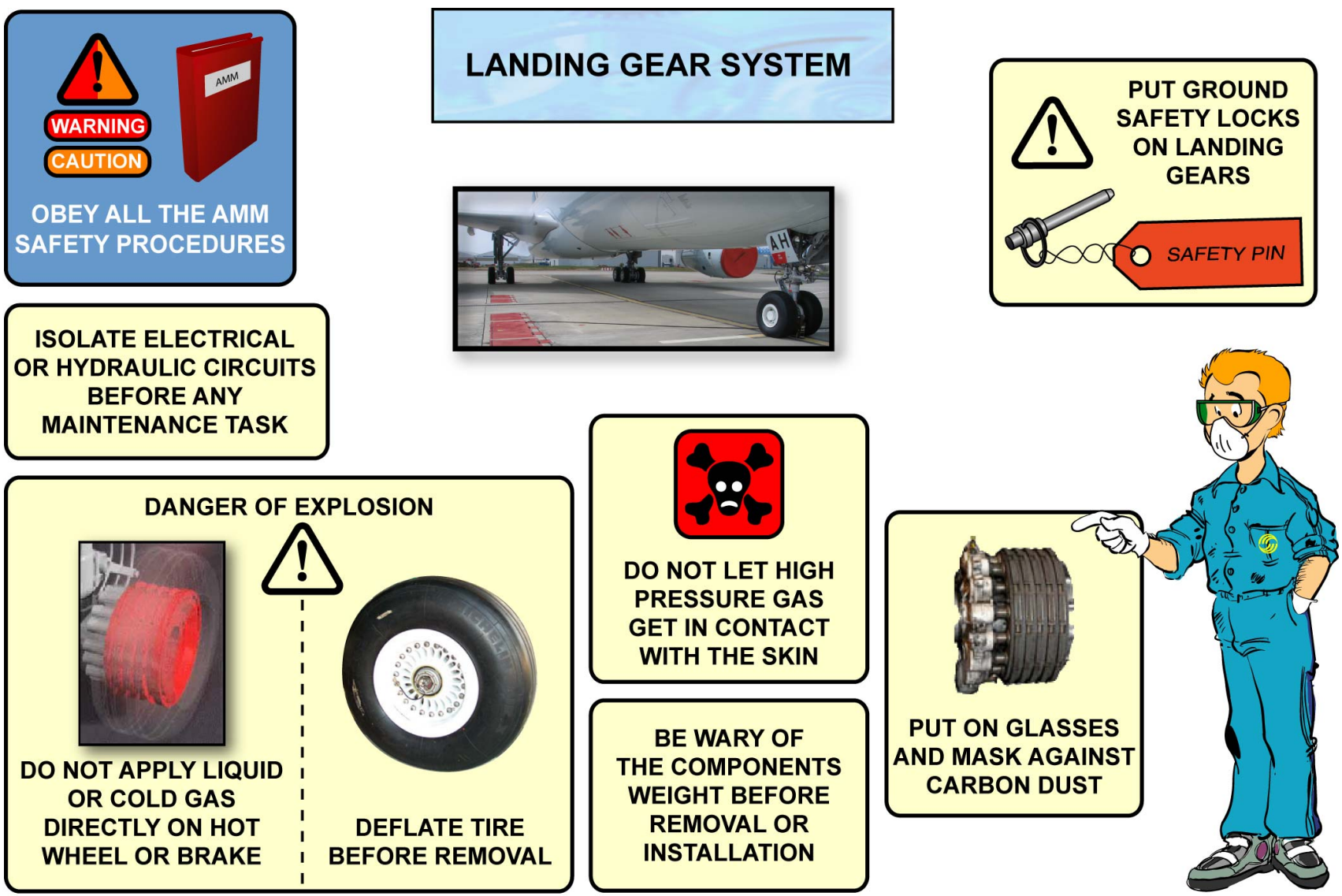
WARNING
CAUTION
AMM
OBEY ALL THE AMM SAFETY PROCEDURES
LANDING GEAR SYSTEM
PUT GROUND SAFETY LOCKS ON LANDING GEARS
SAFETY PIN
ISOLATE ELECTRICAL OR HYDRAULIC CIRCUITS BEFORE ANY MAINTENANCE TASK
DANGER OF EXPLOSION
DO NOT APPLY LIQUID OR COLD GAS DIRECTLY ON HOT WHEEL OR BRAKE
DEFLATE TIRE BEFORE REMOVAL
DO NOT LET HIGH PRESSURE GAS GET IN CONTACT WITH THE SKIN
BE WARY OF THE COMPONENTS WEIGHT BEFORE REMOVAL OR INSTALLATION
PUT ON GLASSES AND MASK AGAINST CARBON DUST

SYSTEM OVERVIEW - SAFETY PRECAUTIONS

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE

INSTALLATION OF THE SAFETY DEVICES ON THE L/G

WARNING: INSTALL ALL SAFETY DEVICES AND WARNING NOTICES BEFORE STARTING ANY MAINTENANCE TASK ON OR NEAR THE L/G, THE L/G DOORS, OR THE FLIGHT CONTROLS. USE SOLVENTS AND CLEANING AGENTS IN WELL-VENTILATED AREAS. MAKE SURE THAT THE WHEEL CHOCKS ARE IN POSITION, MOVEMENTS OF THE A/C COULD BE DANGEROUS.

Install the ground safety lock pins in order to secure the down lock mechanisms. If no other hydraulic servicing tasks have to be completed, the area can be closed. All tools, test and support used during this procedure have to be removed.

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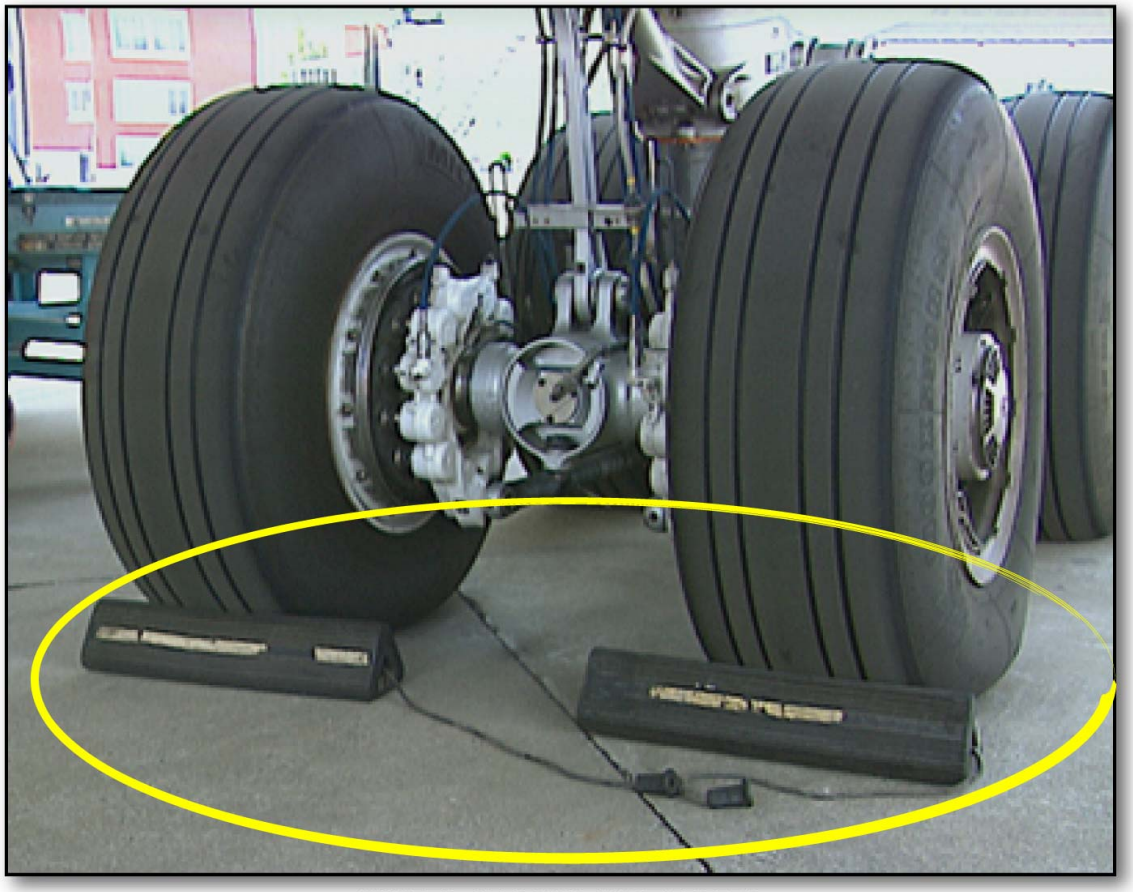
Warnings and Safety precautions.

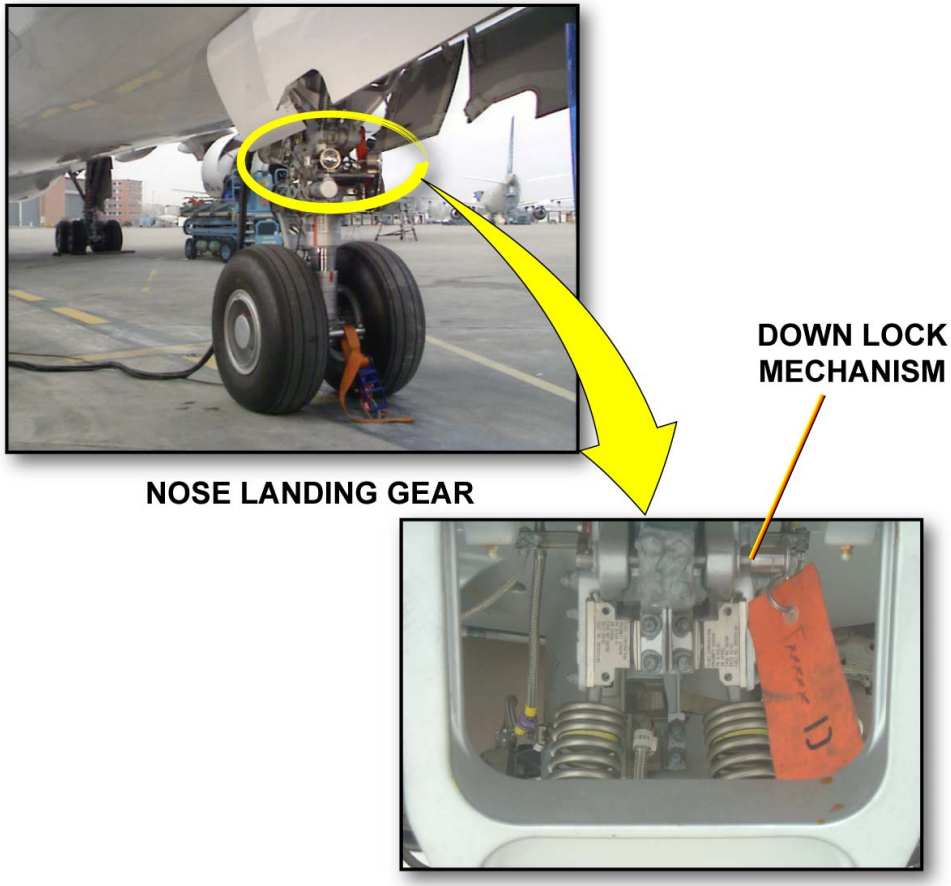


WHEEL CHOCKS (INSTALLED)

MAINTENANCE - INSTALLATION OF THE SAFETY DEVICES ON THE L/G

Installation of the safety devices:

Install the ground safety lock pins in order to secure the down lock mechanisms.



MAINTENANCE - INSTALLATION OF THE SAFETY DEVICES ON THE L/G

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

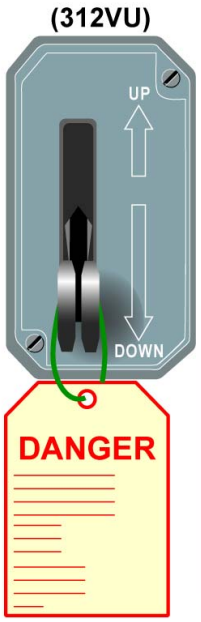
INSTALLATION OF THE SAFETY DEVICES ON THE L/G DOORS

After door ground opening and before starting maintenance tasks inside the L/G bay, the doors must be secured by fitting safety sleeves on the door actuators. Different safety precautions have to be carried out.

The doors are secured by installing the safety collar on each hydraulic actuator. If no other hydraulic servicing tasks have to be completed, the area can be closed. All tools, test and support used during this procedure have to be removed.

Safety precautions.

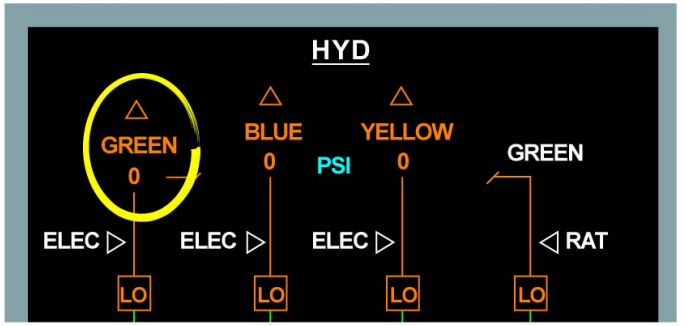
1 L/G LEVER (DOWN POSITION)



2 LDG GEAR GRVTY EXTN SWITCH (OFF POSITION)

4 WHEEL CHOCKS (INSTALLED)

3 GREEN HYD. SYSTEM (DEPRESSURIZED)



MAINTENANCE - INSTALLATION OF THE SAFETY DEVICES ON THE L/G DOORS

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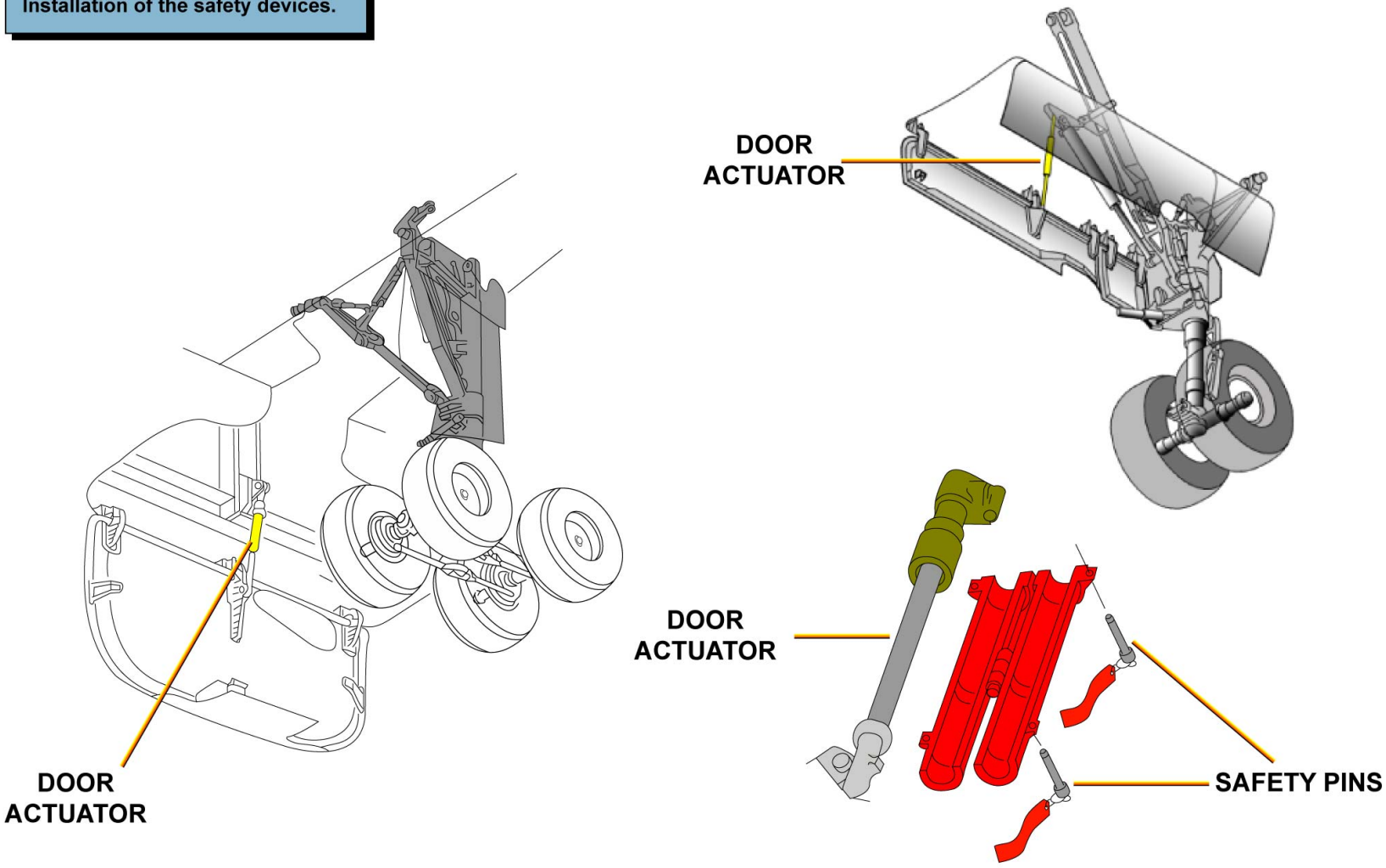
Installation of the safety devices.



MAINTENANCE - INSTALLATION OF THE SAFETY DEVICES ON THE L/G DOORS

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

L/G DOORS GROUND OPENING

Make sure that the L/G lever agrees with the position of the L/G and the free-fall extension switch is in the OFF position. Make sure that the area is clear and the doors can be opened without any obstruction. For the MLG, open the access panel located FWD of the MLG. Pull the ground door-opening handle downwards to open the door uplocks. Secure the handle with the safety pin and install the safety devices on the MLG door actuators.

The NLG ground door-opening handle is installed on the aft bulkhead of the NLG bay. Pull the ground door-opening handle downwards to open the NLG door uplocks. Secure the handle with the safety pin and install the safety devices on the NLG door actuators.

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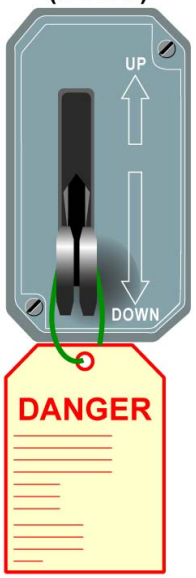
Safety precautions.

LANDING GEAR DOORS (CLOSED)

1 L/G LEVER (DOWN POSITION)

(312VU)



2 LDG GEAR GRVTY EXTN SWITCH (OFF POSITION)

MAINTENANCE - L/G DOORS GROUND OPENING

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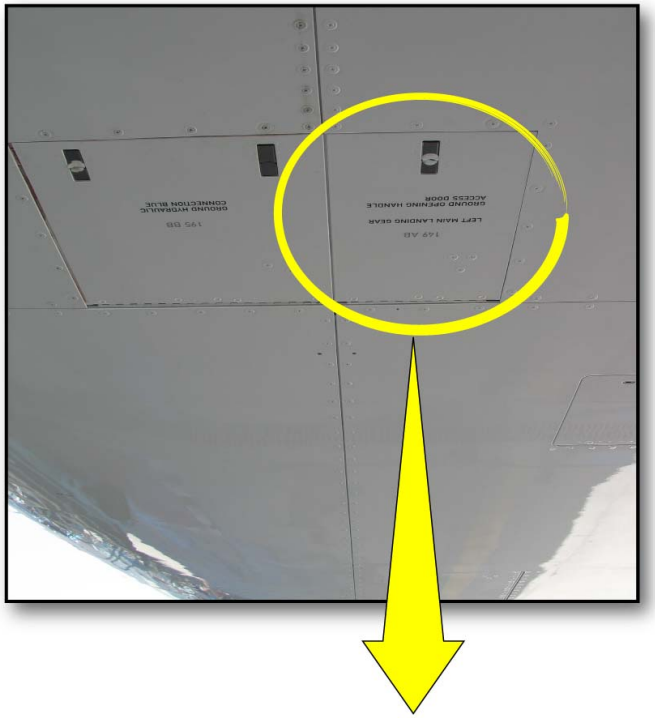
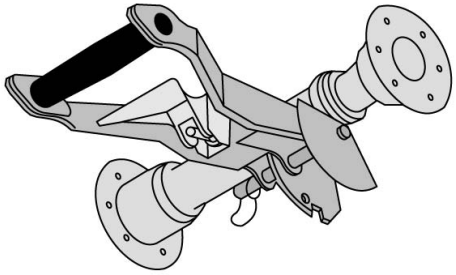
Open the doors:

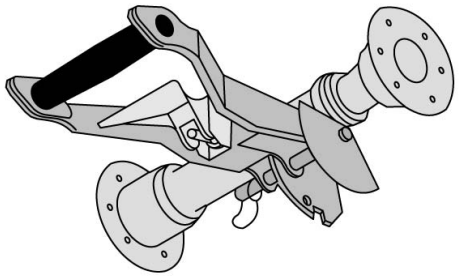
Open the MLG doors.

RIGHT MLG GROUND OPENING HANDLE



LEFT MLG GROUND OPENING HANDLES

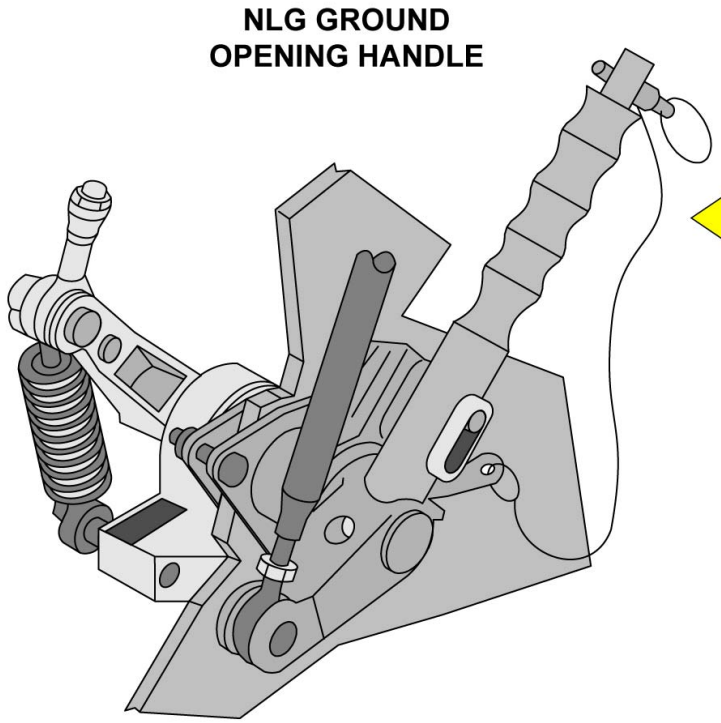


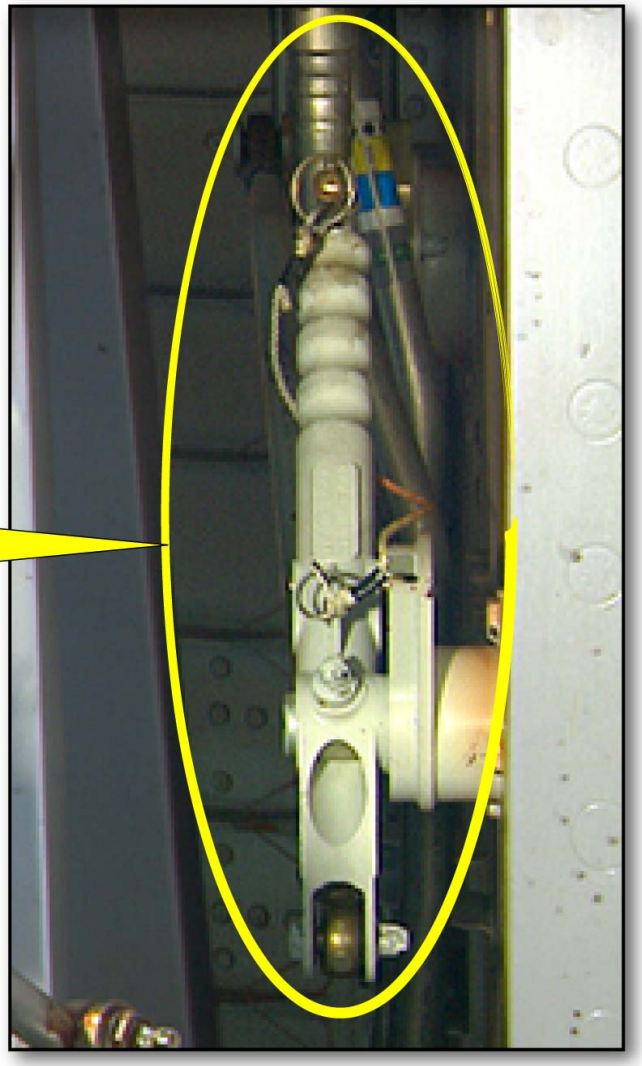


MAINTENANCE - L/G DOORS GROUND OPENING

Open the doors:

Open the NLG doors.





MAINTENANCE - L/G DOORS GROUND OPENING

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

L/G DOORS GROUND CLOSING

Pressurize the green hydraulic system. Remove the safety devices from the door actuators.
Push the ground door-opening handle upward to close the doors, making sure that the uplocks engage. Secure the handle with the safety pin and close the access panel. De-pressurize the green hydraulic system. Remove the ground support equipment, special tooling, access platforms and all warning notices. Make sure that the MLG maintenance doors are closed before dispatch.

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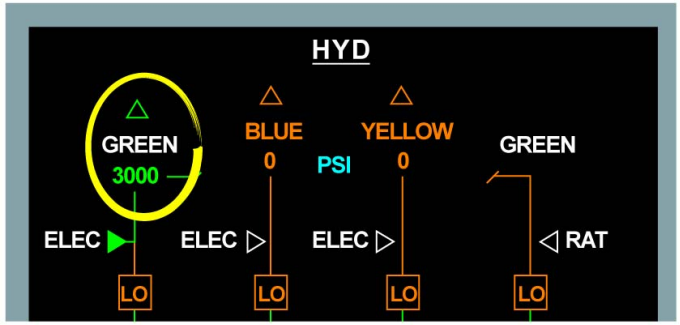
Aircraft maintenance configuration.

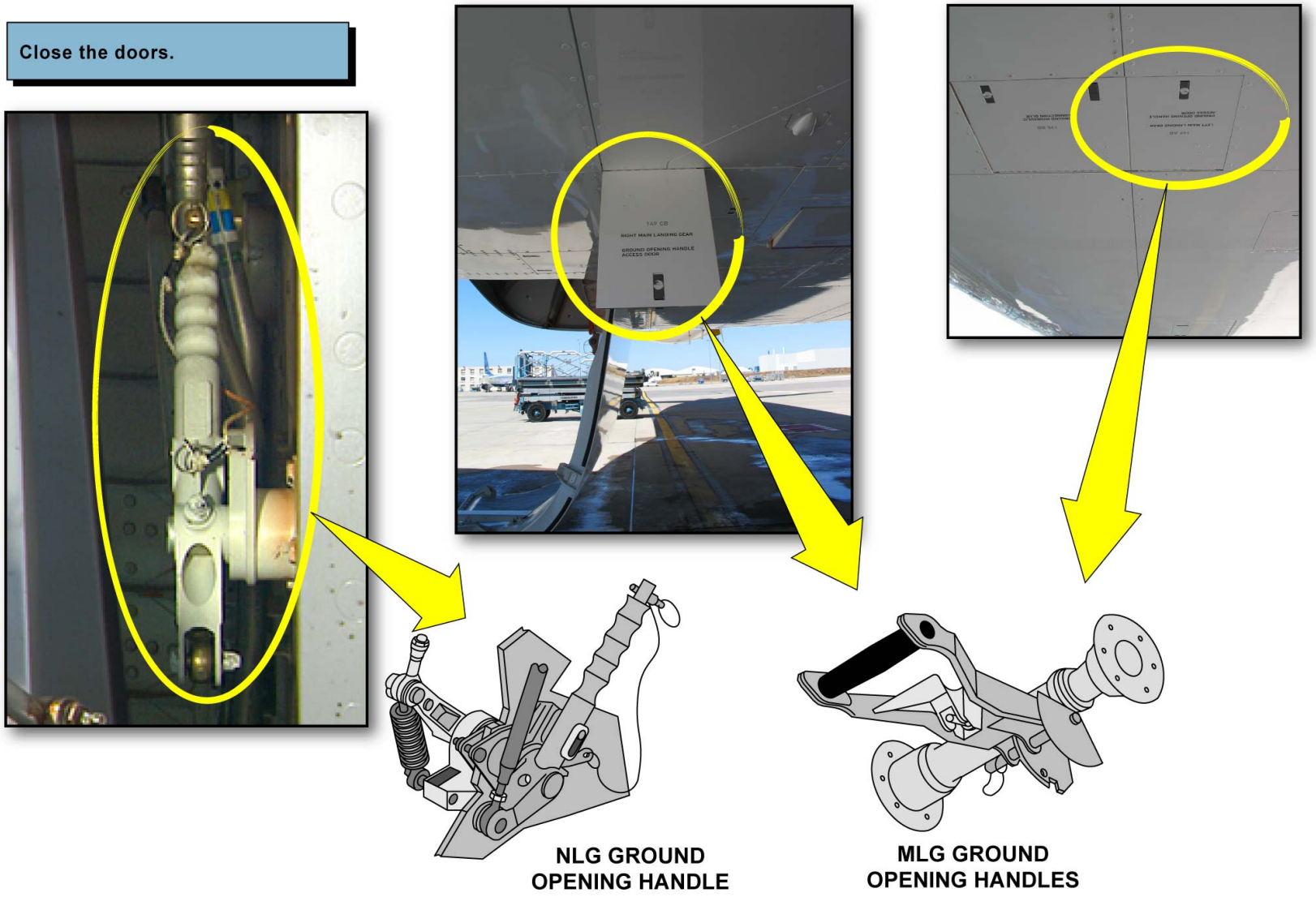
Green hydraulic system pressurized.



ECAM SD

Remove the safety devices from the door actuators.

MAINTENANCE - L/G DOORS GROUND CLOSING



MAINTENANCE - L/G DOORS GROUND CLOSING

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G9409341 - GAUT0T0 - FM32B1000000003

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

TYRE PRESSURE CHECK

Make sure that each tire is cold before you measure its inflation pressure.

NOTE: A tire is cold after approximately 3 hours since its previous operation.

These pressures apply for loaded tires. You must obey the instructions given by the AMM table 32-41-00 when you measure the tire pressures: If there is a large temperature decrease (25 deg C) between the departure and the destination airports, the given tire pressures must be adjusted (Ref. TASK 12-14-32-614-801).
When the tires are still hot if you think that a tire has a low pressure, do a pressure check of the tires on the same landing gear and make a record of the tire pressures:
- identify the highest pressure that you recorded,
- if the pressure of a tire is less than 90% of the highest tire pressure that you recorded, inflates that tire to the highest recorded pressure,
- make a record in the aircraft technical log.

CAUTION: YOU MUST NOT DECREASE THE PRESSURE OF A HOT TIRE.THIS PREVENTS AN INCORRECT LOW PRESSURE WHEN THE TIRE IS COLD.

NOTE: It is possible that the tire pressure can be higher than the maximum nominal value.

G9409341 - GAUT0T0 - FM32B1000000003

AMM TASK 32-41-00-220-802

NLG PRESSURE	MLG PRESSURE	TIRE CONDITION/ACTION NECESSARY
More than 12.0 bar (174 psi)	More than 14.9 bar (216 psi)	Over-inflation. Make sure the measurement is corrrect with another pressure gage. If it is correct, deflate the tire to the maximum normal pressure.
11.4 to 12.0 bar (165-174psi)	14.2 to 14.9 bar (206-216psi)	Normal pressure range. Do not adjust the tire pressure.
10.8 to 11.4 bar (157-165psi)	13.5 to 14.2 bar (196-206psi)	Permitted daily pressure range. Inflate the tire to the maximum normal pressure.
10.3 to 10.8 bar (149-157psi)	12.8 to 13.5 bar (185-196psi)	Under-inflation. Inflate the tire to the maximum normal pressure. The tire pressure must be measured again the next day. If the tire is under-inflated again, you must replace the wheel.
Less than 10.3 bar (149 psi)	Less than 12.8 bar (185 psi)	Leakage of pressure. You must replace the wheel. You must inspect the adjacent wheel.
Less than 9.1 bar (132 psi)	Less than 11.4 bar (166 psi)	Very bad under-inflation or total deflation of the tire. You must replace the wheel. If you cannot be sure that the wheels have not turned while deflated, you must replace the adjacent wheel.

32-41-00

MAINTENANCE - TYRE PRESSURE CHECK

G9409341 - GAUT0T0 - FM32B1000000003

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

CHECK BRAKE PACK WEAR INDICATORS

WARNING: OBEY THE L/G GENERAL WARNINGS AND SAFETY PROCEDURES.
LET THE BRAKES AND WHEELS COOL DOWN BEFORE WORKING ON THEM.
DO NOT USE LIQUID OR GAS FIRE EXTINGUISHERS DIRECTLY ON A HOT WHEEL OR BRAKE.

Make sure that the wheel chocks are in position. Set the PARK BRK to ON and check the accumulator pressure on the blue system triple gauge indicator. If there is at least one brake wear indicator installed and if the indicator is within limits, the brake is serviceable. If there is no wear indicator installed, the brake must be de-activated until it can be replaced.

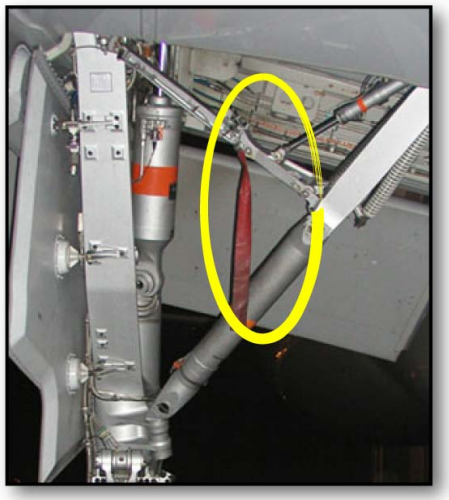
Check each MLG brake wear indicator pin with the parking brake applied. If the brake wear indicator pin is flush with the brake-housing bracket, the brake must be replaced. If no other hydraulic servicing tasks have to be completed, the area can be closed. All tools, test and support used during this procedure have to be removed.

G9409341 - GAUT0T0 - FM32B1000000003

Safety precautions.

Make sure that the wheel chocks are in position. Set the parking brake to ON and check the accu. pressure on the triple gauge indicator.

SAFETY DEVICES (INSTALLED)



SAFETY DEVICES (INSTALLED)

TRIPLE PRESSURE INDICATOR

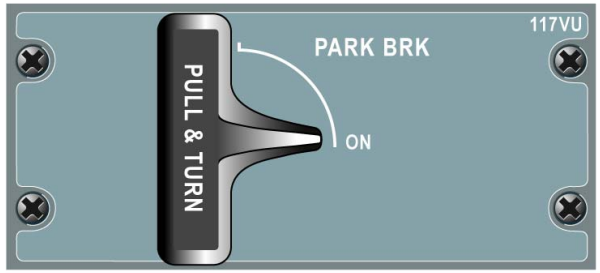
WHEEL CHOCKS (INSTALLED)

MAINTENANCE - CHECK BRAKE PACK WEAR INDICATORS

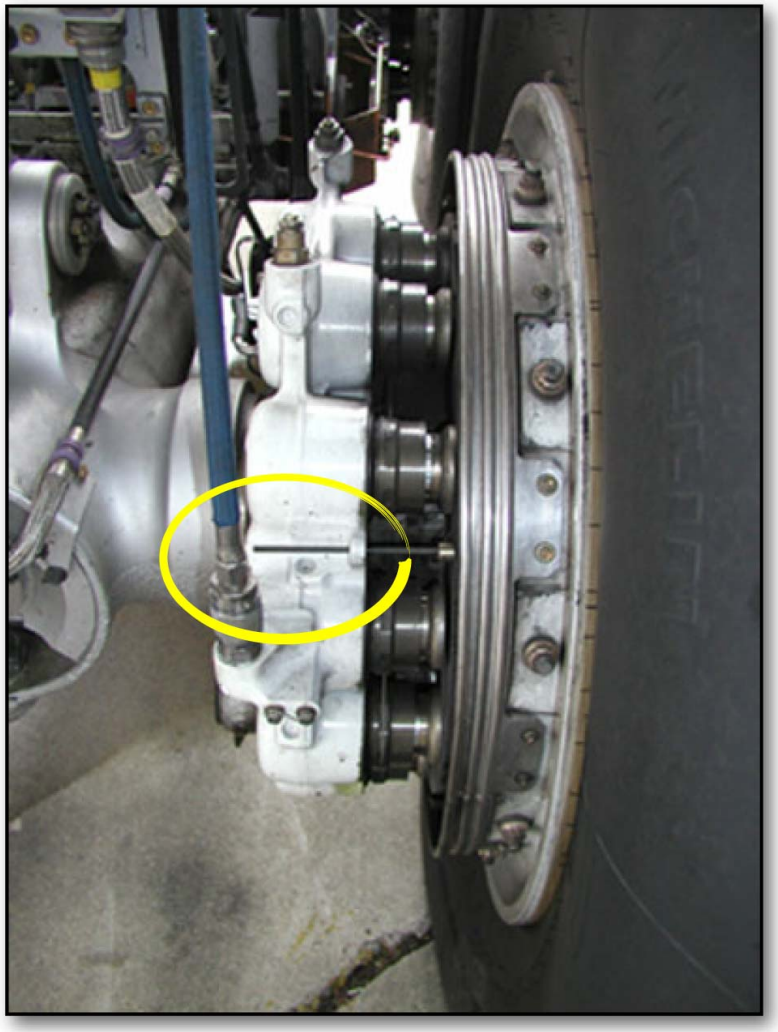
G9409341 - GAUT0T0 - FM32B1000000003

Inspection:

Check each MLG brake wear indicator pin with parking brake applied.



PARKING BRAKE (APPLIED)



BRAKE WEAR INDICATOR (INSTALLED)

MAINTENANCE - CHECK BRAKE PACK WEAR INDICATORS

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G9409341 - GAUT0T0 - FM32B1000000003

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

MLG WHEEL BRAKE DEACTIVATION PROCEDURE

WARNING: MAKE SURE THAT THE SAFETY DEVICES AND THE WARNING NOTICES ARE IN POSITION BEFORE YOU START A TASK ON OR NEAR:
- THE FLIGHT CONTROLS,
- THE FLIGHT CONTROL SURFACES,
- THE LANDING GEAR AND THE RELATED DOORS,
- COMPONENTS THAT MOVE.
MOVEMENT OF COMPONENTS CAN KILL OR INJURE PERSONS.
MAKE SURE THAT THE GROUND SAFETY-LOCKS ARE CORRECTLY INSTALLED ON THE LANDING GEAR. THIS PREVENTS UNWANTED MOVEMENT OF THE LANDING GEAR.

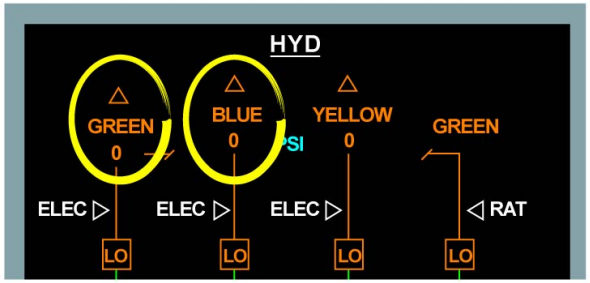
Make sure that the green and blue hydraulic systems are depressurized.
Set the PARK BRK to the OFF position.
Disconnect the half coupling, and use a clean miscellaneous and cleaning agents to clean it.
Safety the half coupling to the brake hose fairlead with the lockwire. Tighten the lockwire and twist to lock it. Put the blanking cap on the fixed half coupling. Remove the blanking screw and the washer from the applicable bleed valve. Use a miscellaneous at the applicable bleed valve to catch the hydraulic fluid. Loosen the bleed valve to release the residual hydraulic pressure from the isolated brake. Tighten the bleed valve and install the washer and the blanking screw. Tighten the blanking screw.
Energize the aircraft electrical circuits. Start the EIS. Pressurize the green hydraulic system. On the right center instrument panel, set the A/SKID switch to ON. Then do the following test:
- fully push in the related brake pedals and hold them in this position,
- make sure that there are no leaks on the green disconnected hydraulic-pressure line,
- release the brake pedals,
- depressurize the green hydraulic system,
- fully push in the related brake pedals and hold them in this position,
- make sure that there are no leaks on the blue disconnected hydraulic-pressure line,
- release the brake pedals,

On the EWD, make sure that the caution BRAKES RELEASED BRAKE * RELEASED does not show. (* = wheel No.). Do the EIS stop procedure and de-energize the aircraft electrical circuits.

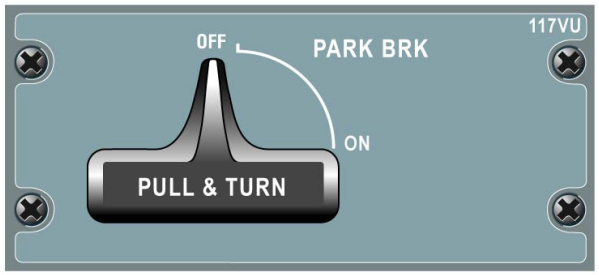
G9409341 - GAUT0T0 - FM32B1000000003

Deactivation of the MLG wheel brake:

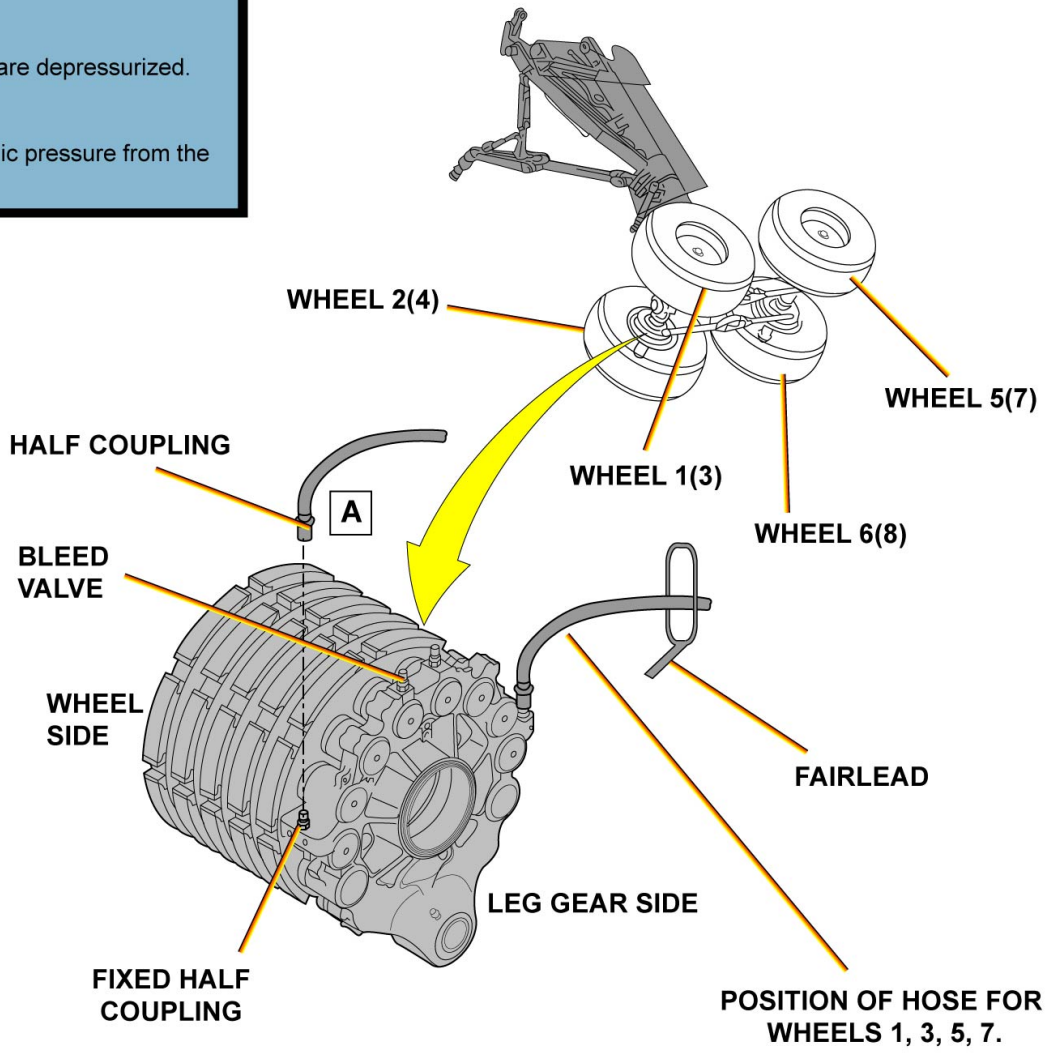
Make sure that the green and blue hydraulic systems are depressurized.
Set the PARK BRK to the OFF position.
Disconnect the half coupling.
Loosen the bleed valve to release the residual hydraulic pressure from the isolated brake.



HYDRAULIC SYSTEMS (DEPRESSURIZED)



PARKING BRAKE (RELEASED)



MAINTENANCE - MLG WHEEL BRAKE DEACTIVATION PROCEDURE

LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

ACTIVATING THE MLG SEAL CHANGEOVER VALVE

Obey the L/G general warnings and safety precautions. Make sure that the green hydraulic system is depressurized and the wheel well doors are closed. Open and safety tag the related C/Bs. Make sure that the MLG safety devices are installed and that the wheel chocks are in place. Place a warning notice in the cockpit to prevent L/G operation. Also place a warning notice not to open the MLG door (if the door is opened while the leg is deflated, the door will touch the ground). Check the access plate to make sure that the spare seal changeover valve has not been activated. If the message "Spare Seal Energized" is visible, the seal has been activated and the shock absorber seals must be replaced.

Remove the access plate, then fully depressurize the shock absorber to get access to the spare seal changeover valve.

Turn the spare seal changeover valve fully clockwise and safety this position.

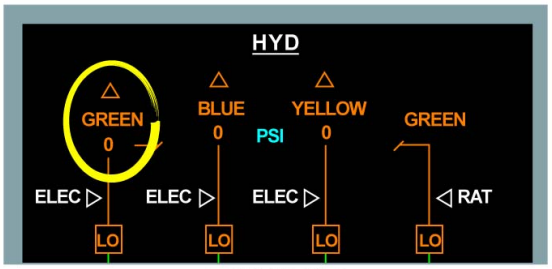
Pressurize the shock absorber, then clean the chromed part of the strut with a clean lint-free cloth and approved cleaning agents.

Check/replenish the fluid contents at the next opportunity. Install the access plate again to display the message "Spare Seal Energized".

Remove the ground support equipment, special tooling, and access platforms. Remove all warning notices and close C/Bs.

G9409341 - GAUT0T0 - FM32B1000000003

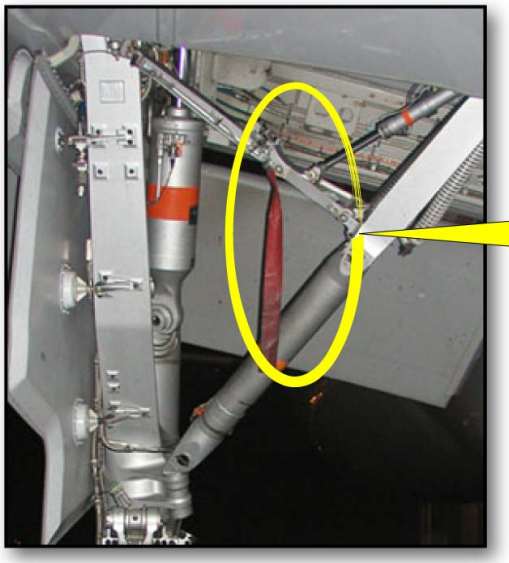
Aircraft maintenance configuration.
Safety precautions.

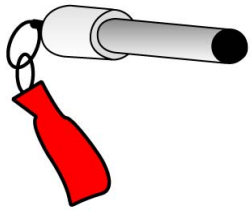


ECAM SD

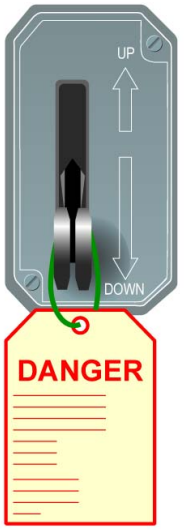
Green hydraulic system depressurized.

WHEELS CHOCKS (INSTALLED)





SAFETY DEVICES (INSTALLED)



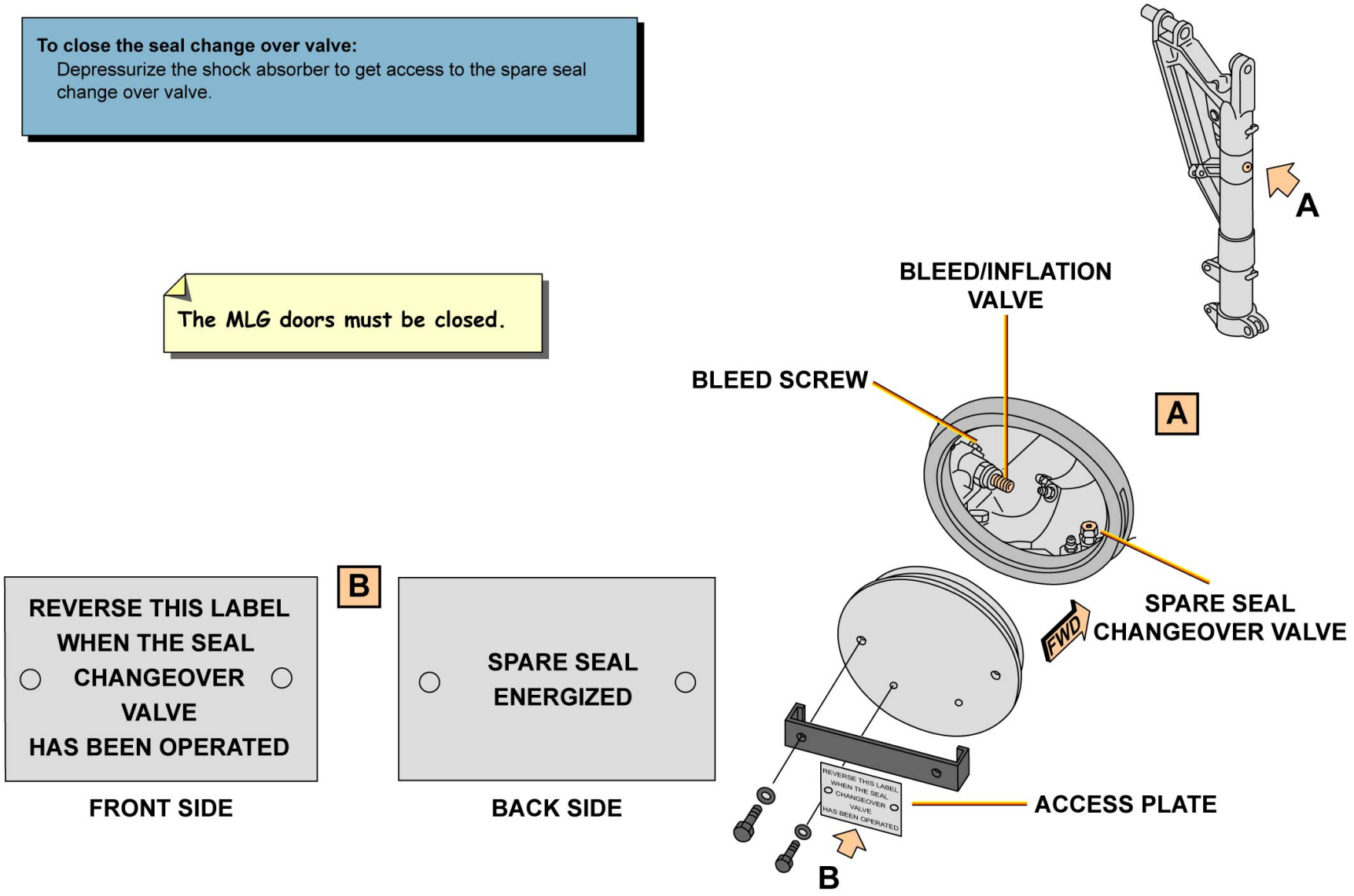
L/G LEVER
(DOWN POSITION)
(312VU)

MAINTENANCE - ACTIVATING THE MLG SEAL CHANGEOVER VALVE

G9409341 - GAUT0T0 - FM32B1000000003

To close the seal change over valve:
Depressurize the shock absorber to get access to the spare seal change over valve.

The MLG doors must be closed.

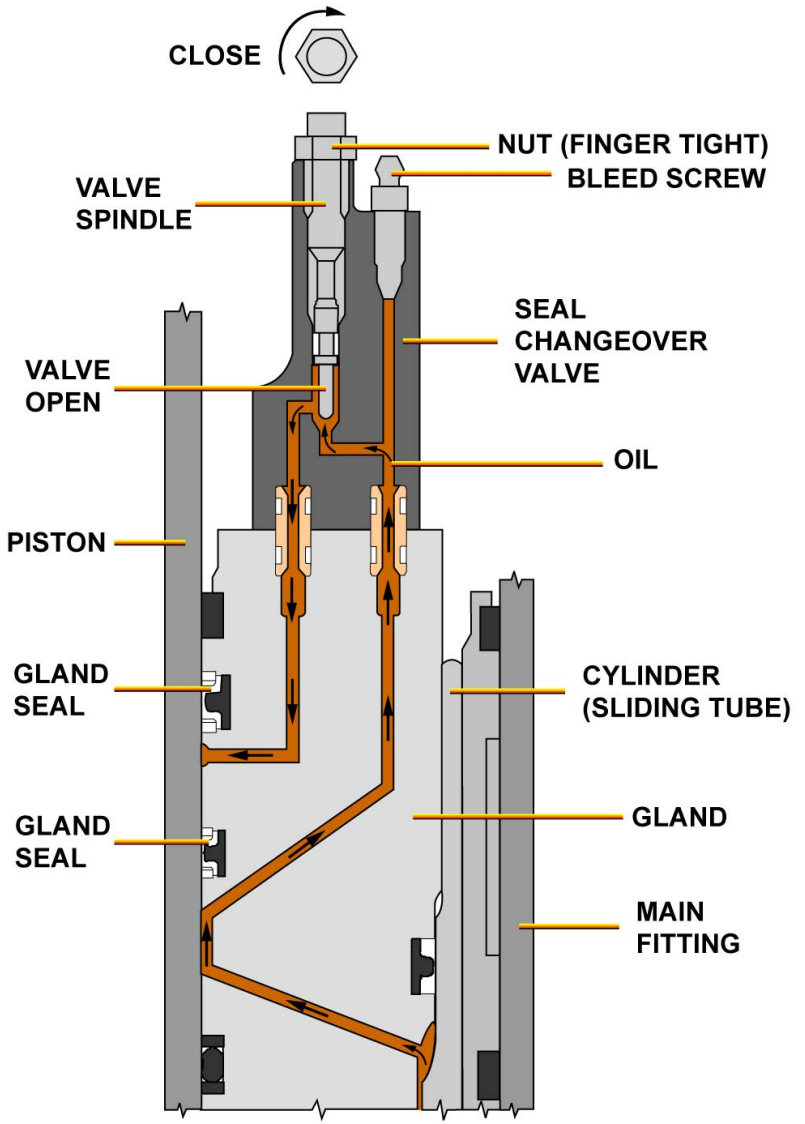


MAINTENANCE - ACTIVATING THE MLG SEAL CHANGEOVER VALVE

G9409341 - GAUT0T0 - FM32B1000000003

To close the seal change over valve:
Turn the valve clockwise to activate the second seal.

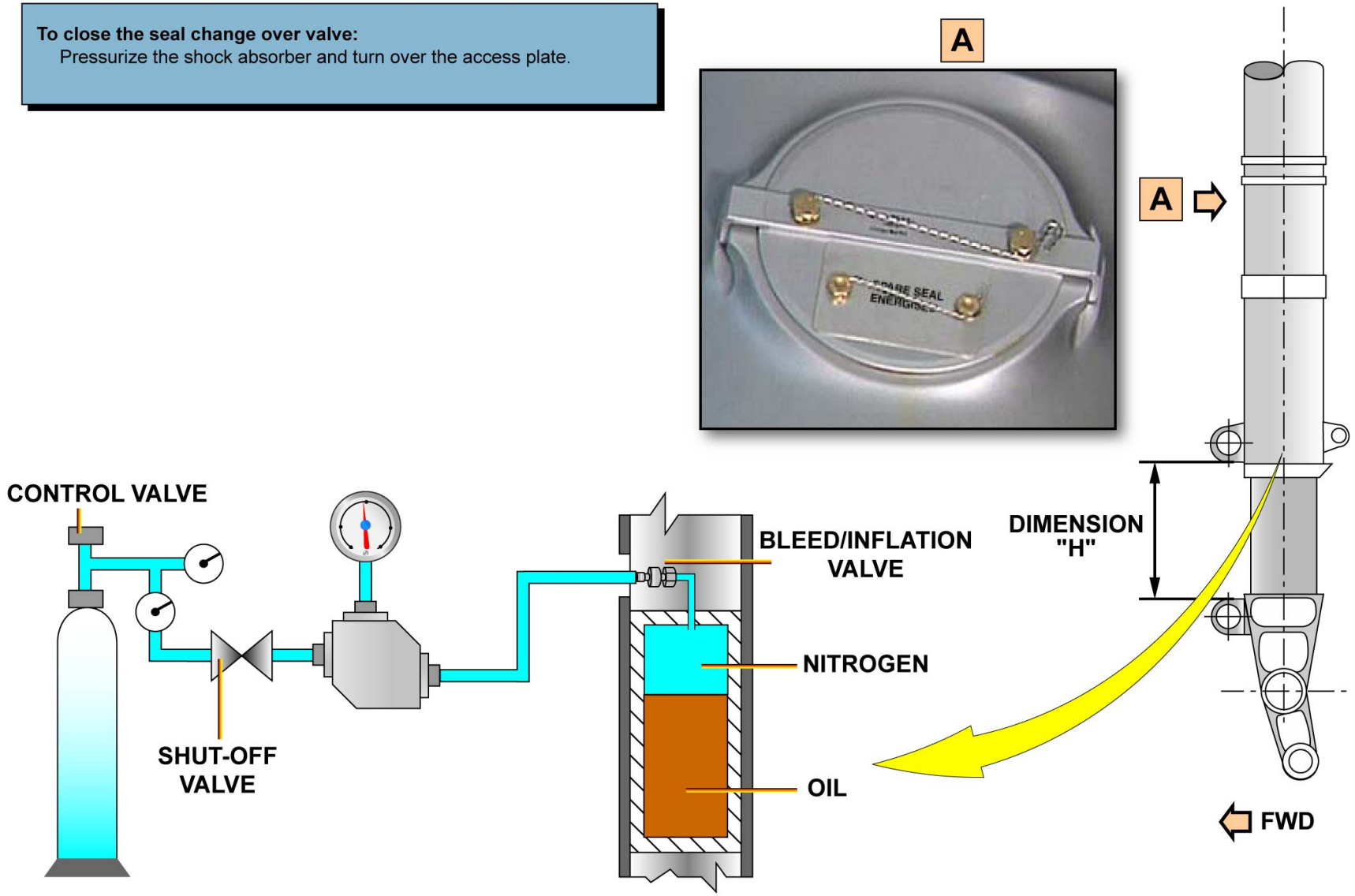
The seal changeover valve is shown 90 degrees from its normal position.



MAINTENANCE - ACTIVATING THE MLG SEAL CHANGEOVER VALVE

G9409341 - GAUT0T0 - FM32B1000000003

To close the seal change over valve:
Pressurize the shock absorber and turn over the access plate.



MAINTENANCE - ACTIVATING THE MLG SEAL CHANGEOVER VALVE

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LANDING GEAR SYSTEM LINE MAINTENANCE BRIEFING (2)

MAINTENANCE (continued)

ACTIVATING THE NLG SEAL CHANGEOVER VALVE

Place a warning notice in the cockpit to prevent L/G operation and make sure that the wheel chocks are in place. Make sure that the green hydraulic system is depressurized. Open the NLG doors and fit the NLG safety devices on the door actuator. Open and safety tag the related C/Bs.

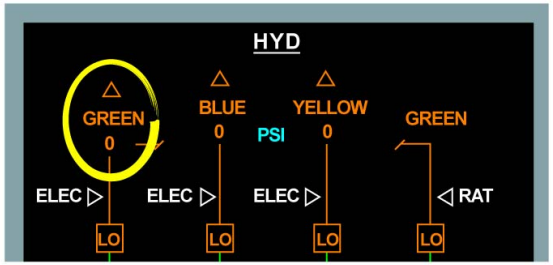
Check that the colored band of the spare seal changeover valve is in view. This confirms that the valve has not been already activated. If it has been activated, the NLG shock absorber seals have to be replaced. Remove the cap screw. Turn the seal changeover valve counter clockwise until it is closed. The colored band will be out of view. Install the cap screw and safety the cap screw with a lock wire. Clean the chromed part of the NLG shock strut with a clean lint-free cloth and approved cleaning agents. Check/replenish the fluid contents of the NLG shock strut at the next opportunity. Remove the ground support equipment, special tooling, and access platforms. Remove all warning notices. Close C/Bs.

G9409341 - GAUT0T0 - FM32B1000000003

Safety precautions.
Aircraft maintenance configuration.

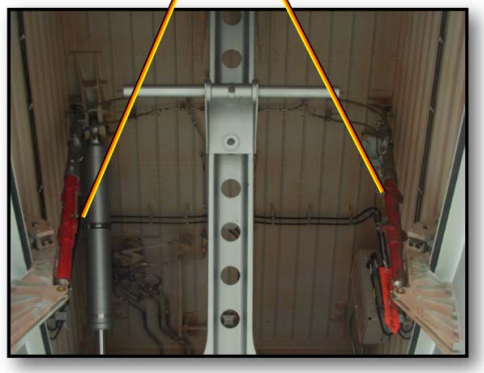
Green hydraulic system depressurized.

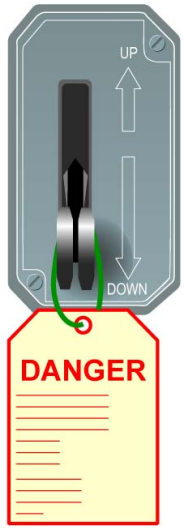
SAFETY DEVICE (INSTALLED)



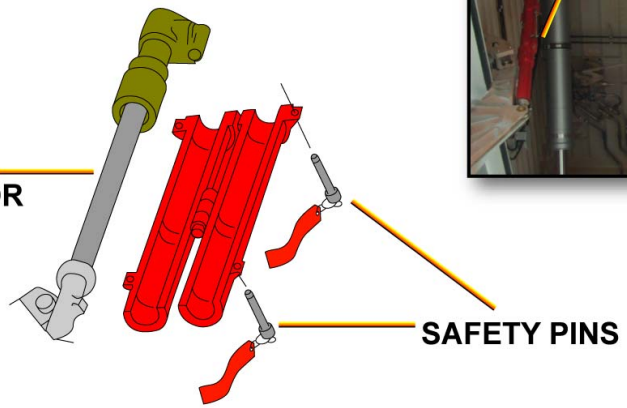
ECAM SD

DOOR ACTUATORS





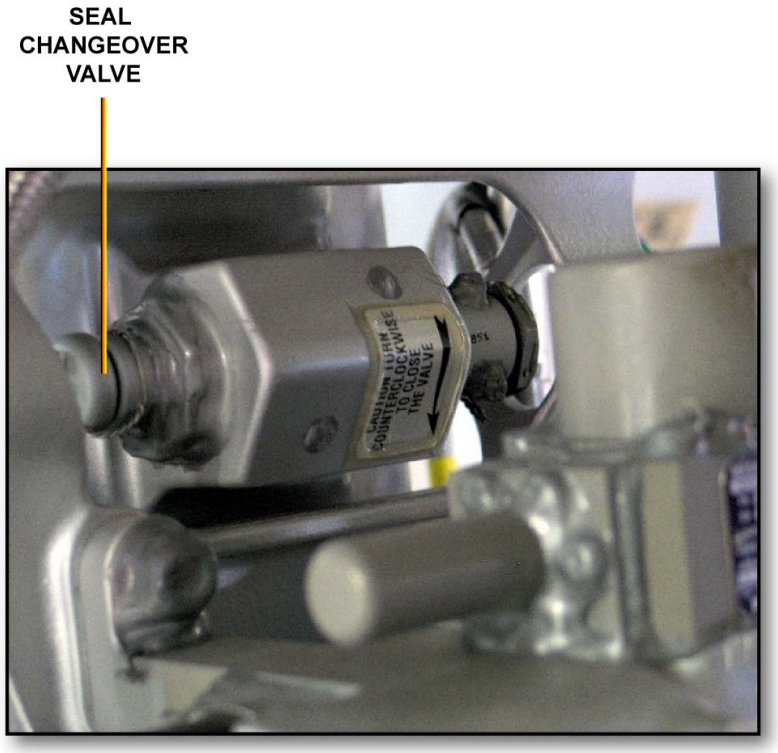
L/G LEVER
(DOWN POSITION)
(312VU)

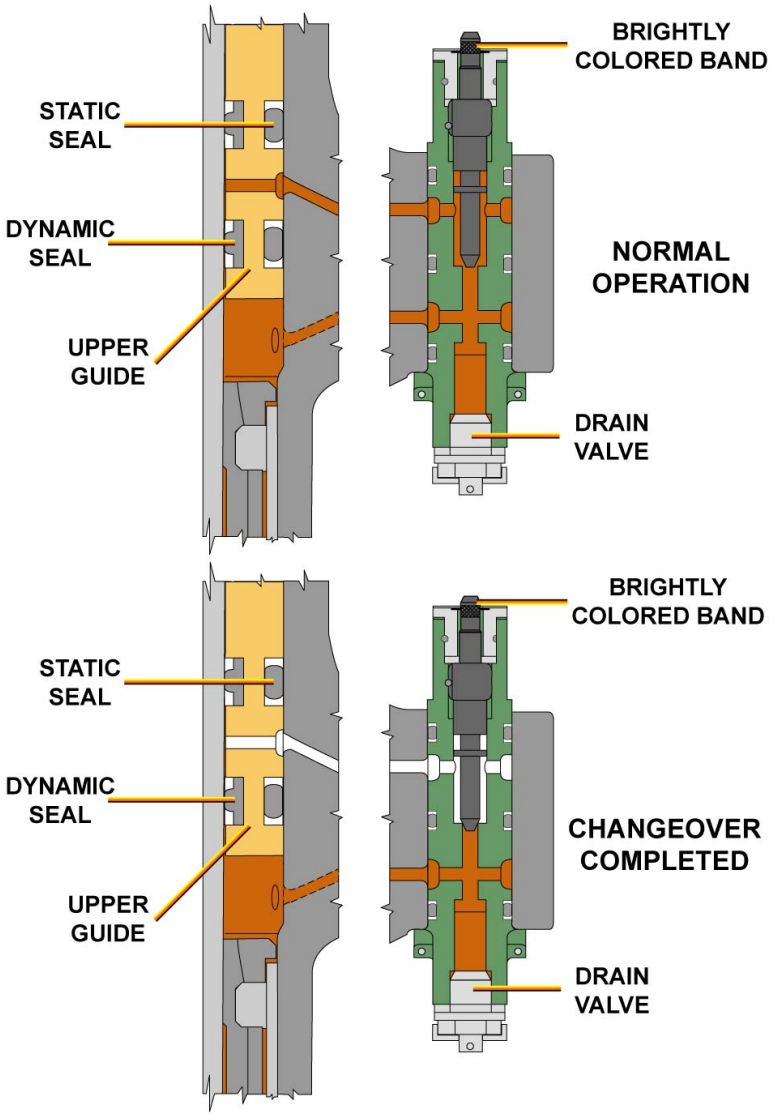


MAINTENANCE - ACTIVATING THE NLG SEAL CHANGEOVER VALVE

To close the seal changeover valve:

Check the colored band to confirm the valve status.
Remove the cap screw and turn the valve counter clockwise to activate the second seal. Check the colored band is out of view.





MAINTENANCE - ACTIVATING THE NLG SEAL CHANGEOVER VALVE

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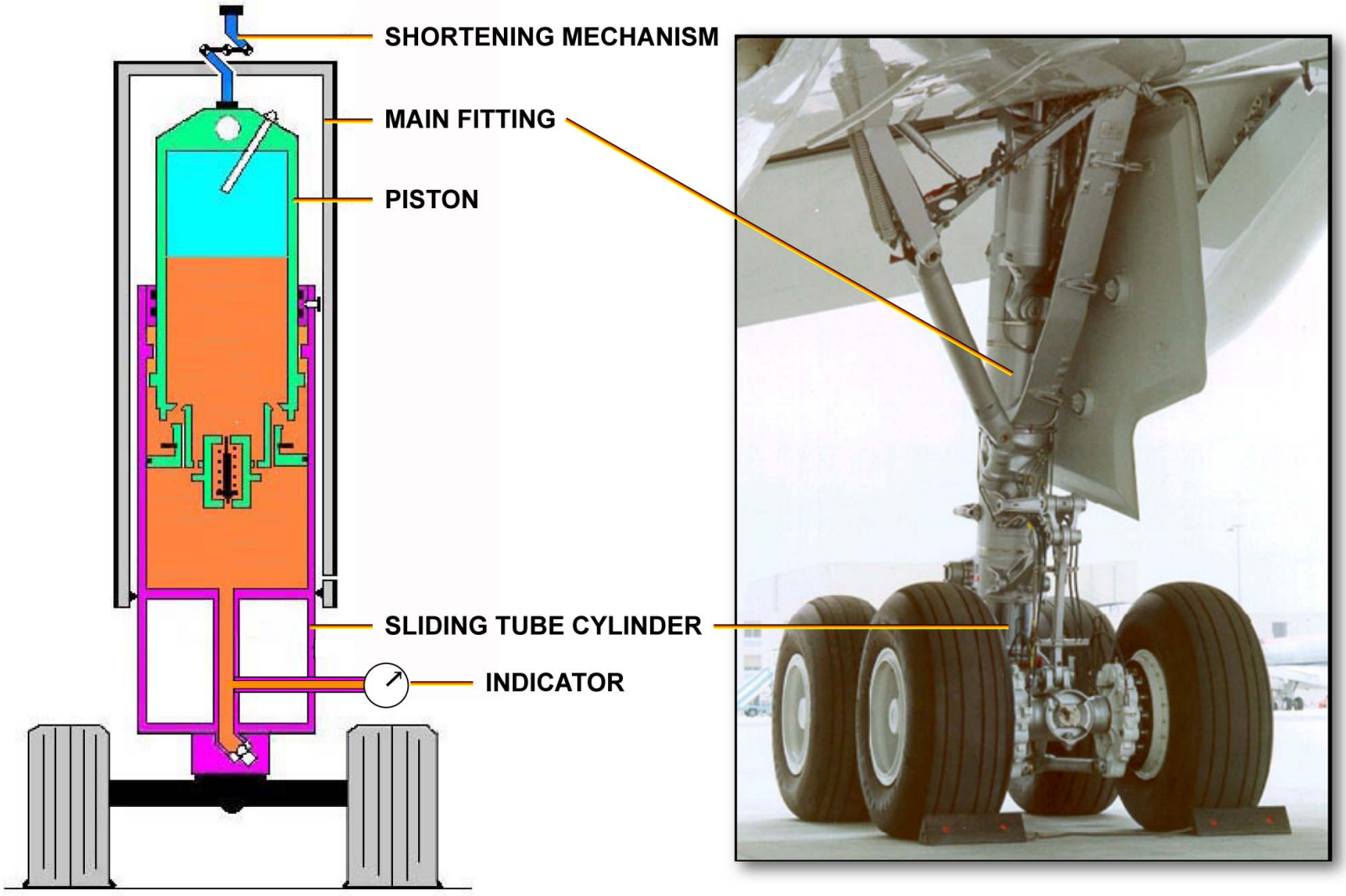
LANDING GEAR SPECIAL FEATURES (3)

MLG SHOCK ABSORBER

The shock absorber absorbs the taxi, take-off and landing loads. The shock absorber is a capsule type that includes a sliding tube. It is an oleo-pneumatic unit that is installed in the main fitting. When it is compressed the load is transmitted to the hydraulic fluid and gas that fill the shock absorber. The recoil stroke is slow, which makes sure that the aircraft does not become airborne again after it touches down on landing.
The cylinder is the part of the shock absorber that moves when the landing, take off or taxi loads increase or decrease. Its external face has a wear-resistant surface at the bearing interfaces. The cylinder operates around the piston, where the compression of the gas occurs.
During the compression stroke, the cylinder moves up around the piston. Thus the volume in the cylinder decreases. This increases the pressure in the piston chamber. As the hydraulic fluid flows into the piston chamber, the gas compresses to absorb the compression load.
The pressure in the piston chamber forces the hydraulic fluid to return to the cylinder chamber. At the same time, the volume of recoil chamber is decreased. As the cylinder (sliding tube) extends, seals against the piston seal closed ports in the piston to decrease the flow from the recoil chamber. Thus the recoil slows at the end of the shock absorber extension stroke.

G9409341 - GAUT0T0 - FM32D1000000002



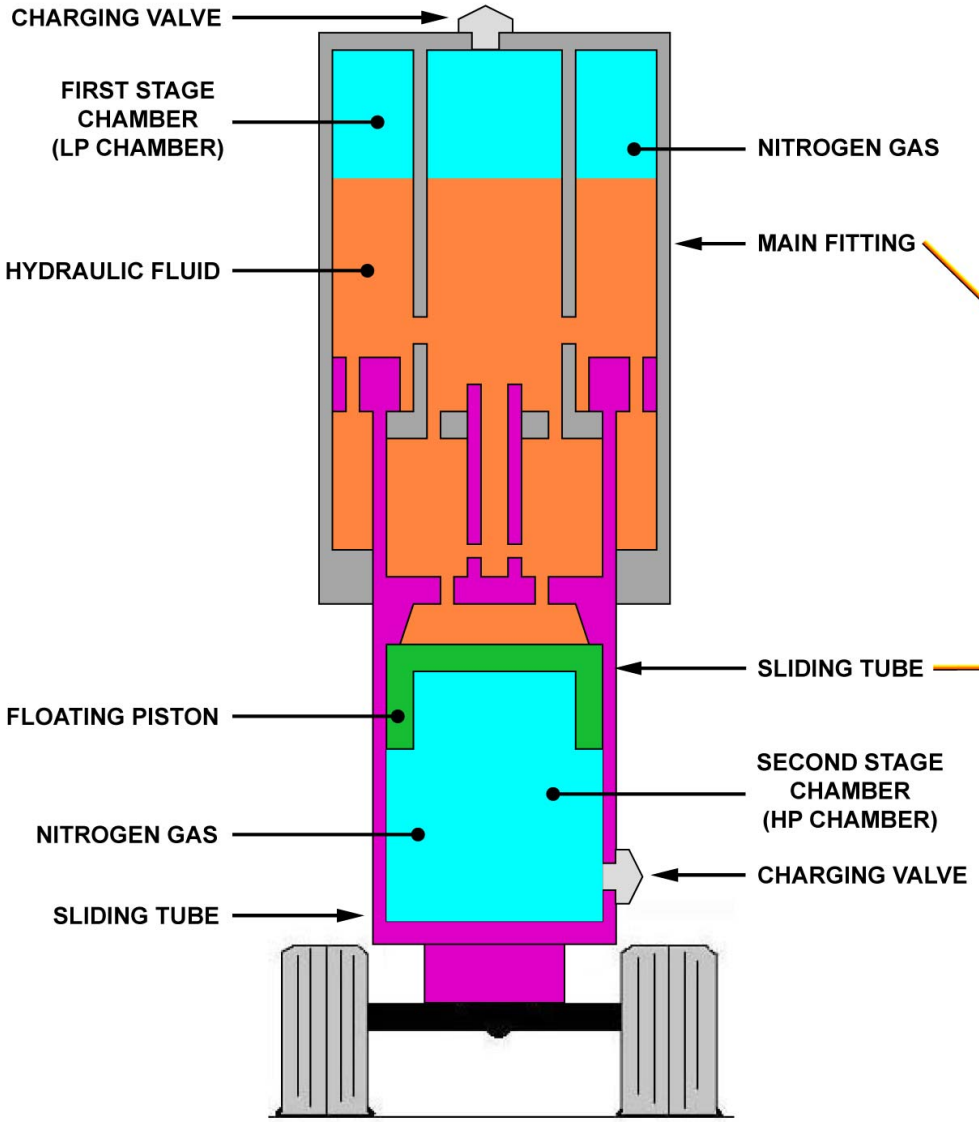
MLG SHOCK ABSORBER

LANDING GEAR SPECIAL FEATURES (3)

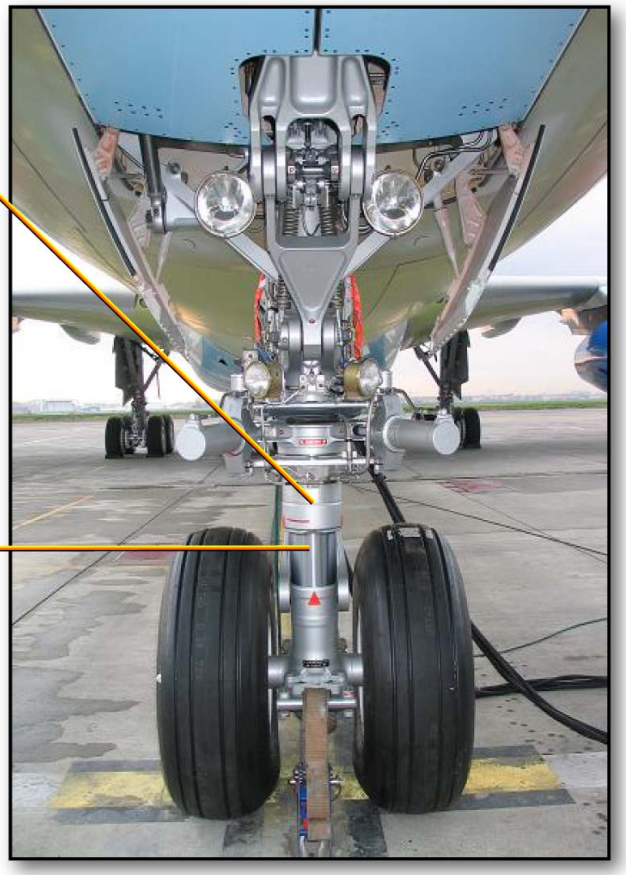
NLG/CLG SHOCK ABSORBER

The shock absorber is a two-chamber, oleo-pneumatic telescopic strut, made from the main fitting and the sliding tube. The main fitting has a first stage chamber with nitrogen gas and hydraulic fluid, with no separation between the gas and the fluid. The sliding tube has a second stage high-pressure gas chamber. A floating piston in the sliding tube separates the first stage chamber from the second stage chamber. Damping rings and fixed orifices in the upper and lower diaphragm control the movement of the fluid between the first and second stages to decrease the speed at which the shock absorber extends. There is also a damping ring between the first stage chamber and the recoil chamber.

G9409341 - GAUT0T0 - FM32D1000000002



SHOCK ABSORBER



NLG/CLG SHOCK ABSORBER

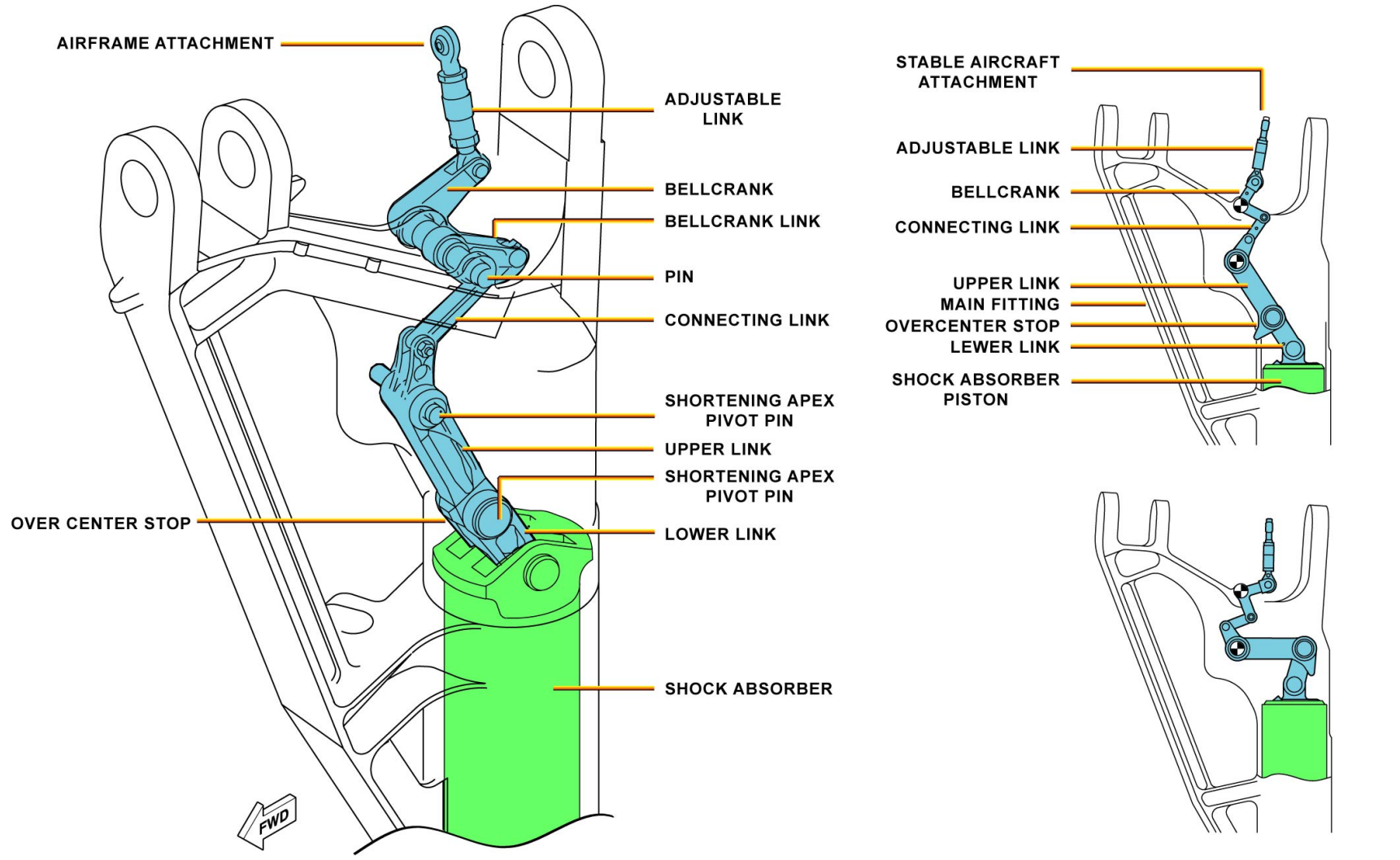
G9409341 - GAUT0T0 - FM32D1000000002

LANDING GEAR SPECIAL FEATURES (3)

SHORTENING MECHANISM

During retraction the shortening mechanism operates to decrease the length of the L/G. Forces are transmitted through the adjustable link to the bellcrank lever, which pushes the connecting link to turn the upper link. As the upper link starts to turn it breaks the overcenter lock and draws the lower link up. This pulls the shock absorber up into the main fitting so that the MLG can go into the bay. When the landing gear control lever is set to DOWN position, the movement of the MLG also causes the shortening mechanism to extend the shock absorber. When the shock absorber is fully extended the shortening links are overcenter and transmit shock absorber loads to the structure of the aircraft.

G9409341 - GAUT0T0 - FM32D1000000002



SHORTENING MECHANISM

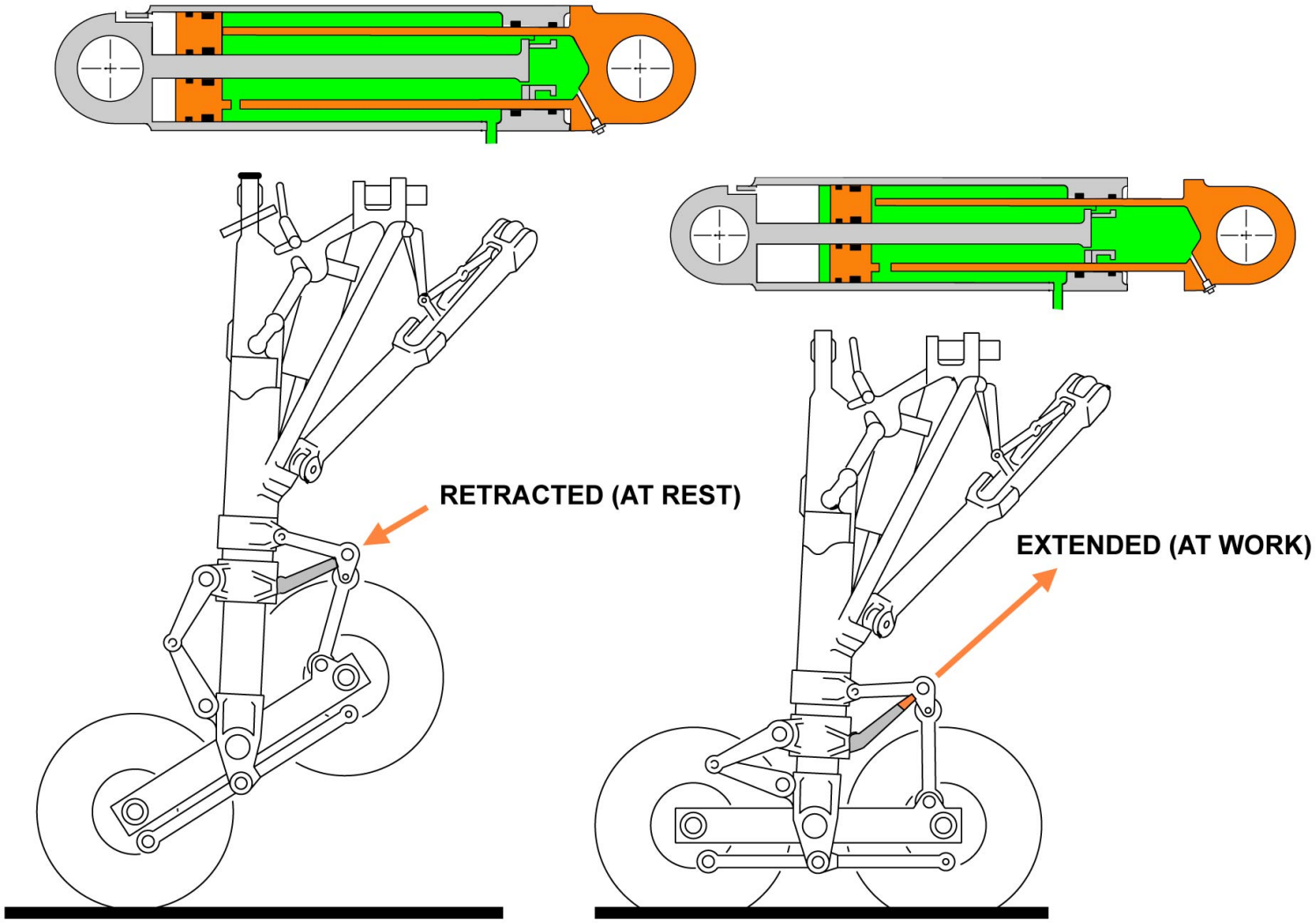
G9409341 - GAUT0T0 - FM32D1000000002

LANDING GEAR SPECIAL FEATURES (3)

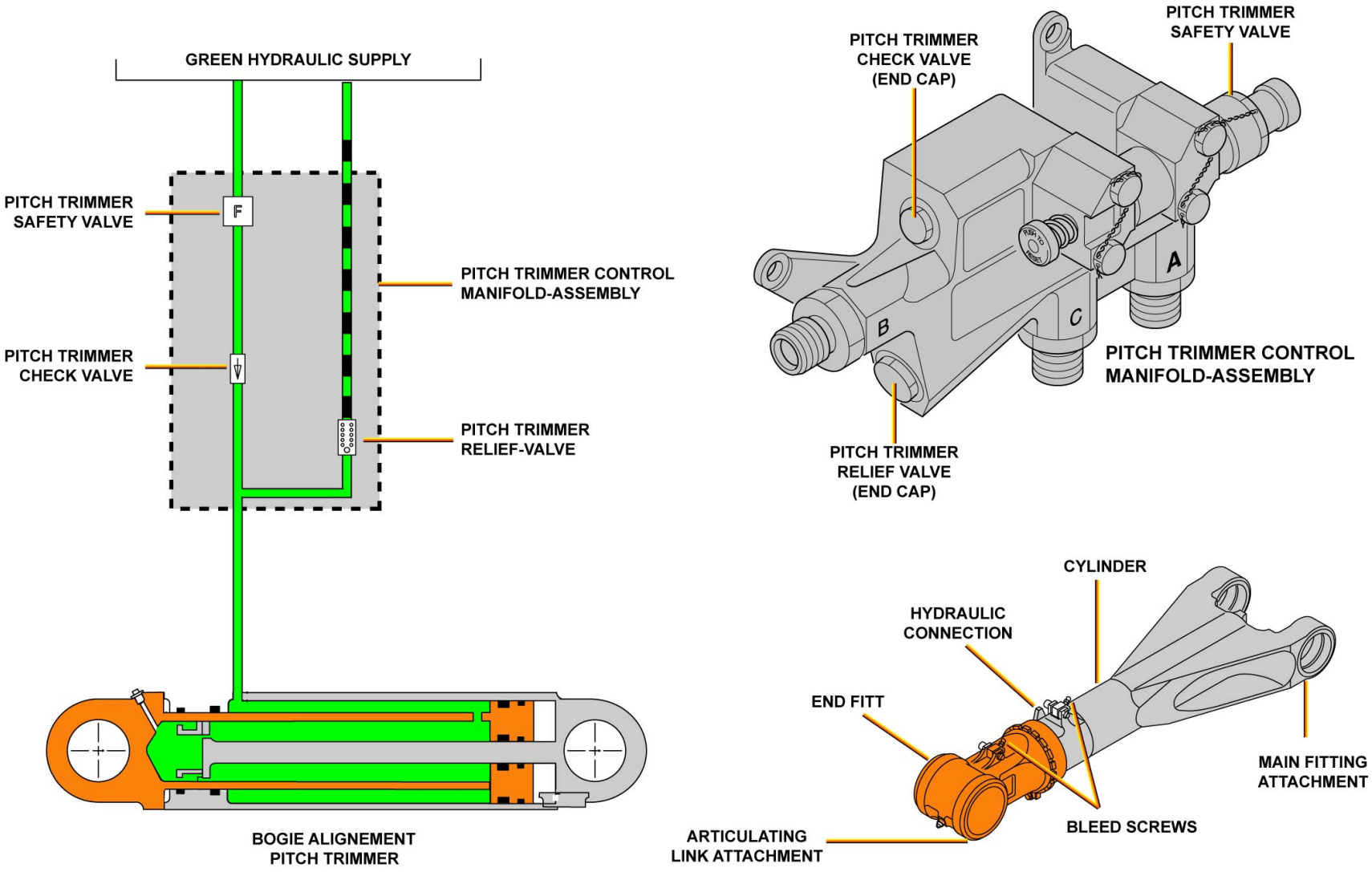
MLG PITCH TRIMMER

The retracted and extended position.
The Pitch trimmer is a hydraulically operated cylinder installed between the main fitting and articulating links. It has a cylinder, a piston rod. The cylinder has a bleed screw and a vent plug. The bleed screw lets you bleed air from the pitch trimmer. Hydraulic pressure is continuously supplied to the pitch trimmer when the Green hydraulic system is pressurized. When there is no mechanical force on the pitch trimmer, hydraulic pressure causes the piston rod to stay in the retracted position. When the piston extends, free flow hydraulic fluid goes through the two way bi-directional restrictor and the pressure relief valve to the return line. When the external force is released from the pitch trimmer the green hydraulic system pressure causes the piston rod to retract.
When the aircraft starts to leave the ground during a take-off, the load on the MLG decreases. This lets the shock absorber extend and the pitch trimmer retract. As the pitch trimmer retracts, it operates the articulating links, which subsequently turn the bogie (front wheels up). When the piston of the pitch trimmer gets to its external stop, the shock absorber continues to extend, which further turns the bogie to its trim angle.
The movement of the bogie beam and the extension of the shock absorber increase the overall length of the MLG. This lets the aircraft move through a large angle during a take-off. During retraction of the MLG, the shortening mechanism causes the articulating links to move the bogie beam back to its lateral position (for entry into the MLG bay).

G9409341 - GAUT0T0 - FM32D1000000002



MLG PITCH TRIMMER



MLG PITCH TRIMMER

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LANDING GEAR SPECIAL FEATURES (3)

SEAL CHANGEOVER VALVE

The seal changeover valve is installed in the main fitting in a manifold. The manifold is attached to a lug on the gland housing that holds the shock absorber gland seals. The upper bearing of the shock absorber is installed on the external surface of the gland housing and the sliding member. The gland housing holds the primary and secondary seals. In normal operation of the shock absorber the primary seals are used and the secondary seals are balanced through oil pressure on the two sides of the seal. If the primary seal leaks, the changeover valve stops the oil pressure to one side of the seal to operate the secondary seals.
MLG
NLG
CLG

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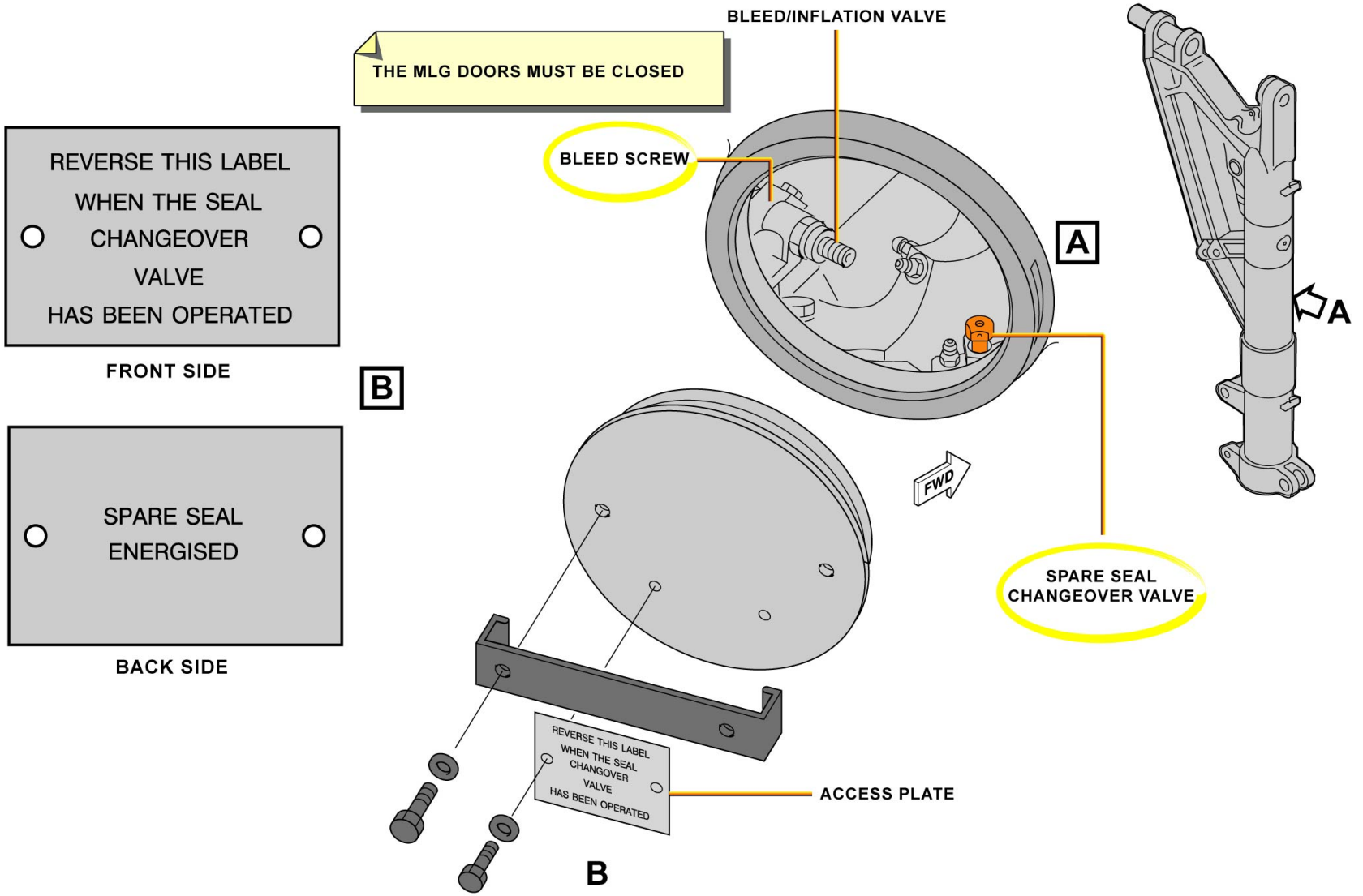

SEAL CHANGEOVER VALVE

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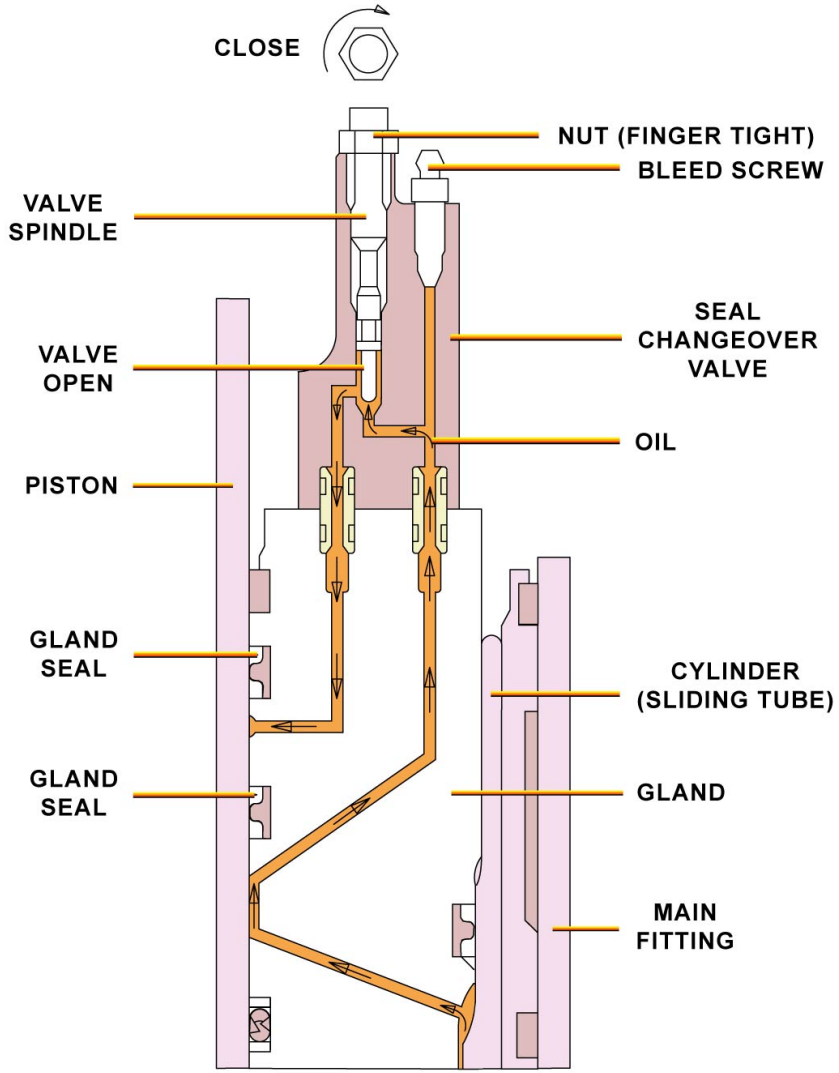
THE SEAL CHANGEOVER VALVE IS SHOWN 90 DEGREES FROM ITS NORMAL POSITION



SEAL CHANGEOVER VALVE

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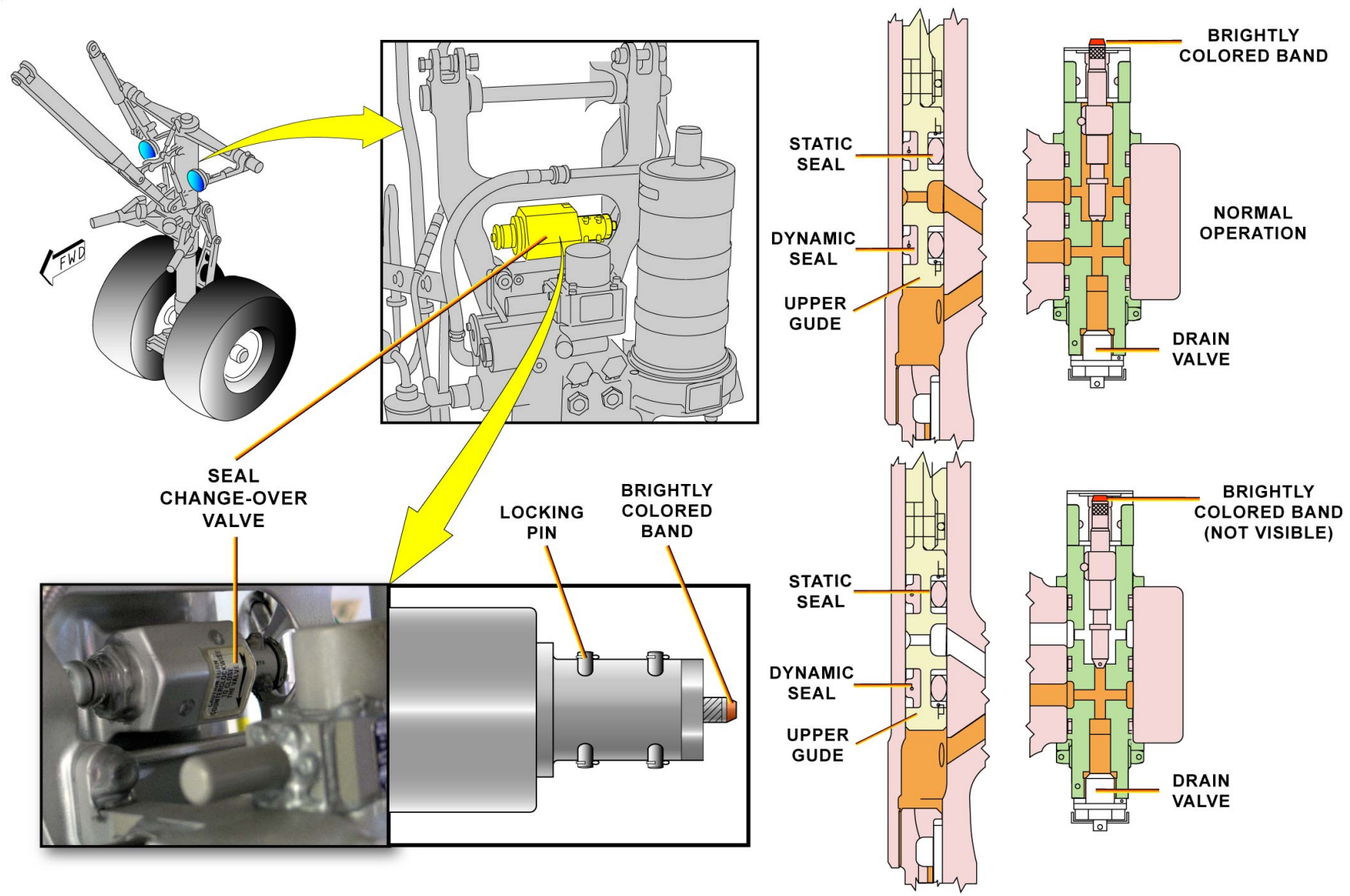

SEAL CHANGEOVER VALVE

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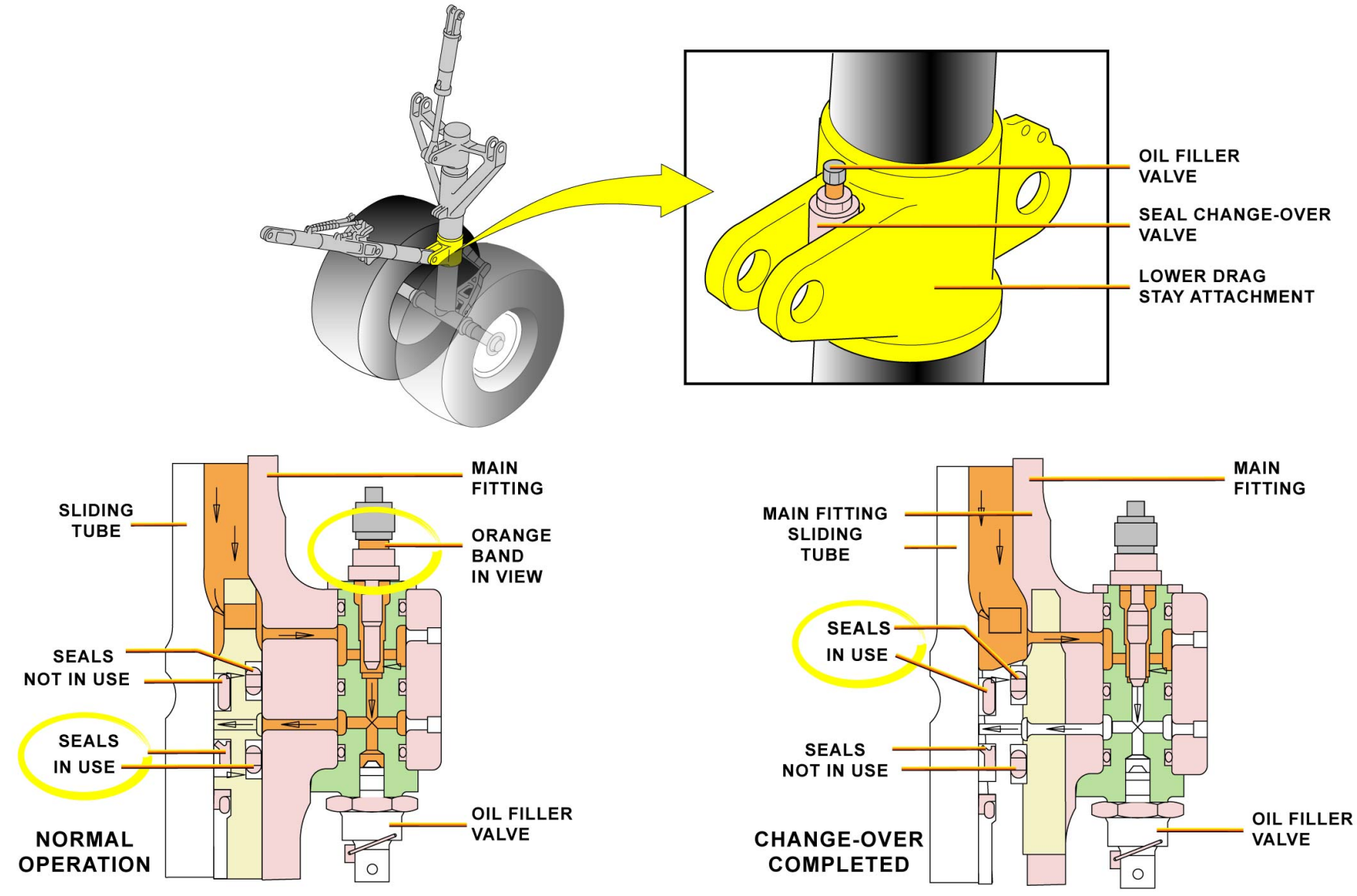

SEAL CHANGEOVER VALVE

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NORMAL EXTENSION AND RETRACTION D/O (3)

ELECTRICAL SYSTEM

An hydro-electrical system controls the operation of the L/G extension and retraction sequences. The system has two independently connected sub-systems, identified as SYSTEM 1 and SYSTEM 2 and these are electrically isolated from each other.
Each sub-system contains a Landing Gear Control and Interface Unit (LGCIU) and a number of proximity sensors. The proximity sensors are electronic position indicators and are installed on the mechanical components of each L/Gs and doors.
Both LGCIUs are continuously electrically supplied but only one LGCIU is active and controls the operation of the extension/retraction sequence.
An LGCIU change-over occurs when gear UP is selected or if the active LGCIU fails. The LGCIU calculates the necessary door and gear configuration signals. It compares them with the configuration requested from the L/G control lever. It then sends the necessary signals to operate the selector valves which provide fluid to all gears and doors.
The LanDinG GEAR indicator displays green triangle when the corresponding gear is downlocked. The information is given by an independent circuitry for each gear. The signals go through LGCIU 1 position. The UNLK is in red when the corresponding gear is not locked (UP or DOWN).
The The LGCIU controls the operation of the baulk solenoid in the L/G control lever. After take-off, gear and bogie signals are sent to the LGCIUs. Each LGCIU sends a signal to release the baulk. The baulk solenoid stops the movement of the lever to the UP position:
- when the A/C is on the ground,
- when the L/G is not in the correct configuration for retraction.

The L/G system is equipped with an isolation safety valve. The isolation safety valve is de-energized closed when the A/C airspeed is more than 280 Kts. As a consequence, the L/G is isolated from the green hydraulic system and cannot be extended.

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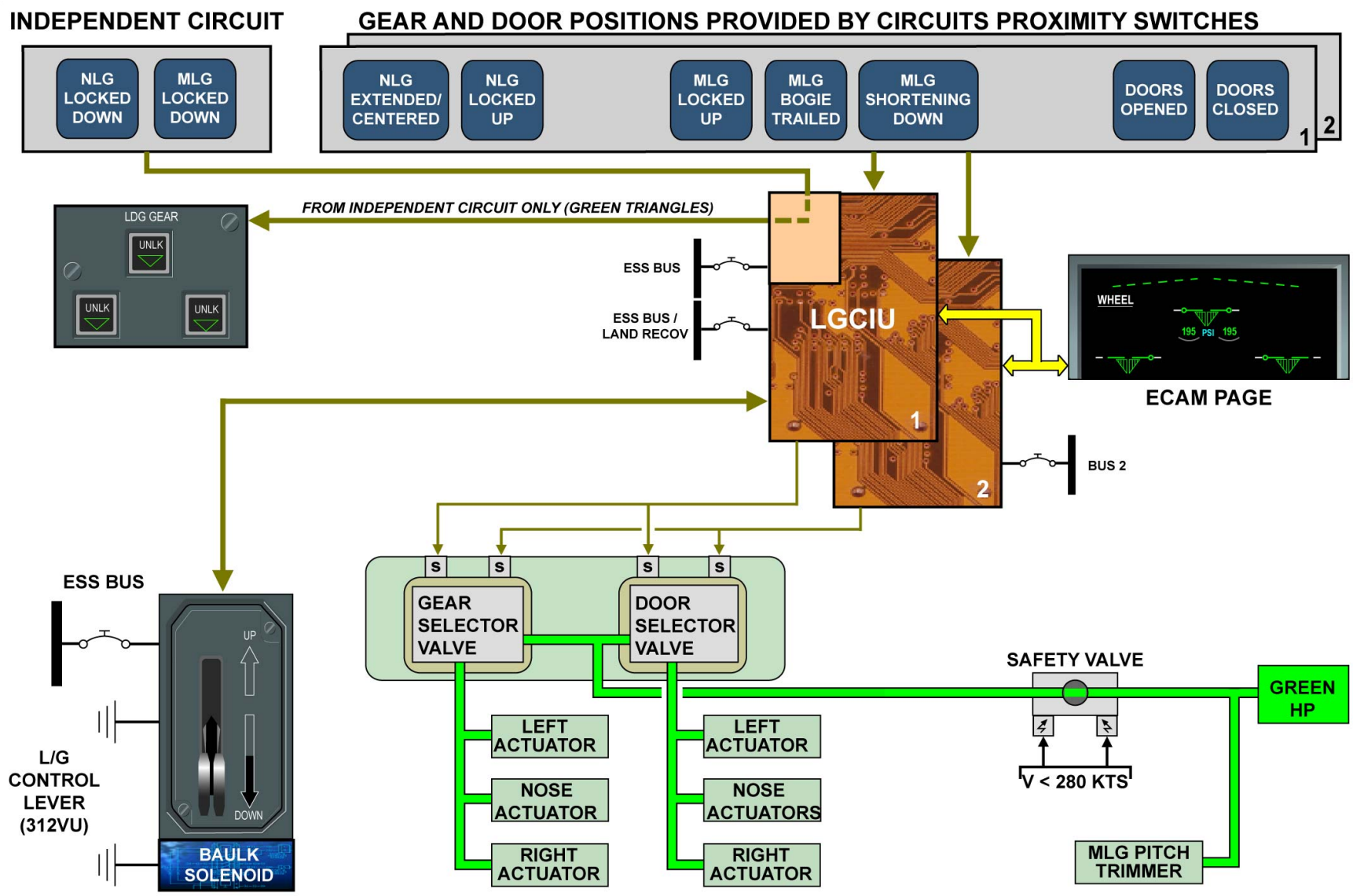

ELECTRICAL SYSTEM

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES

The normal L/G extension and retraction sequences will be described.

GENERAL

The L/G operational sequence is controlled by the LGCIUs in response to information received from the proximity sensors. These signals are used to establish the current configuration of the L/G, either locked down or locked up, and the configuration of the door, either closed or fully open.
The configuration of the shock absorbers and bogie beams are also monitored. It enables the release of the L/G selector baulk during gear retraction or extension.

L/G LOCKED DOWN, DOORS CLOSED

For clarity purpose, the schematic sequence only displays the R/H gear and door operation (the principle is similar for the other gears and doors). The LGCIUs take into account the L/G lever position and the gears and doors position provided by the proximity sensors.
Here, the sequence starts with the LGCIU 2 active before a lever UP selection. Note: The Nose Wheel Steering (NWS) is hydraulically supplied by the door close circuit and 2 hydraulic fuses (which close in case of leak) are on the door open and close circuits.
When the L/G lever is in the DOWN position, the following conditions are maintained. The door selector valve DOOR CLOSED solenoid is energized and the DOOR CLOSED hydraulic lines are pressurized. All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.
Pressure in the DOOR CLOSED lines will maintain the doors in the closed position. The gear downlock remains in the overcentred locked down condition.

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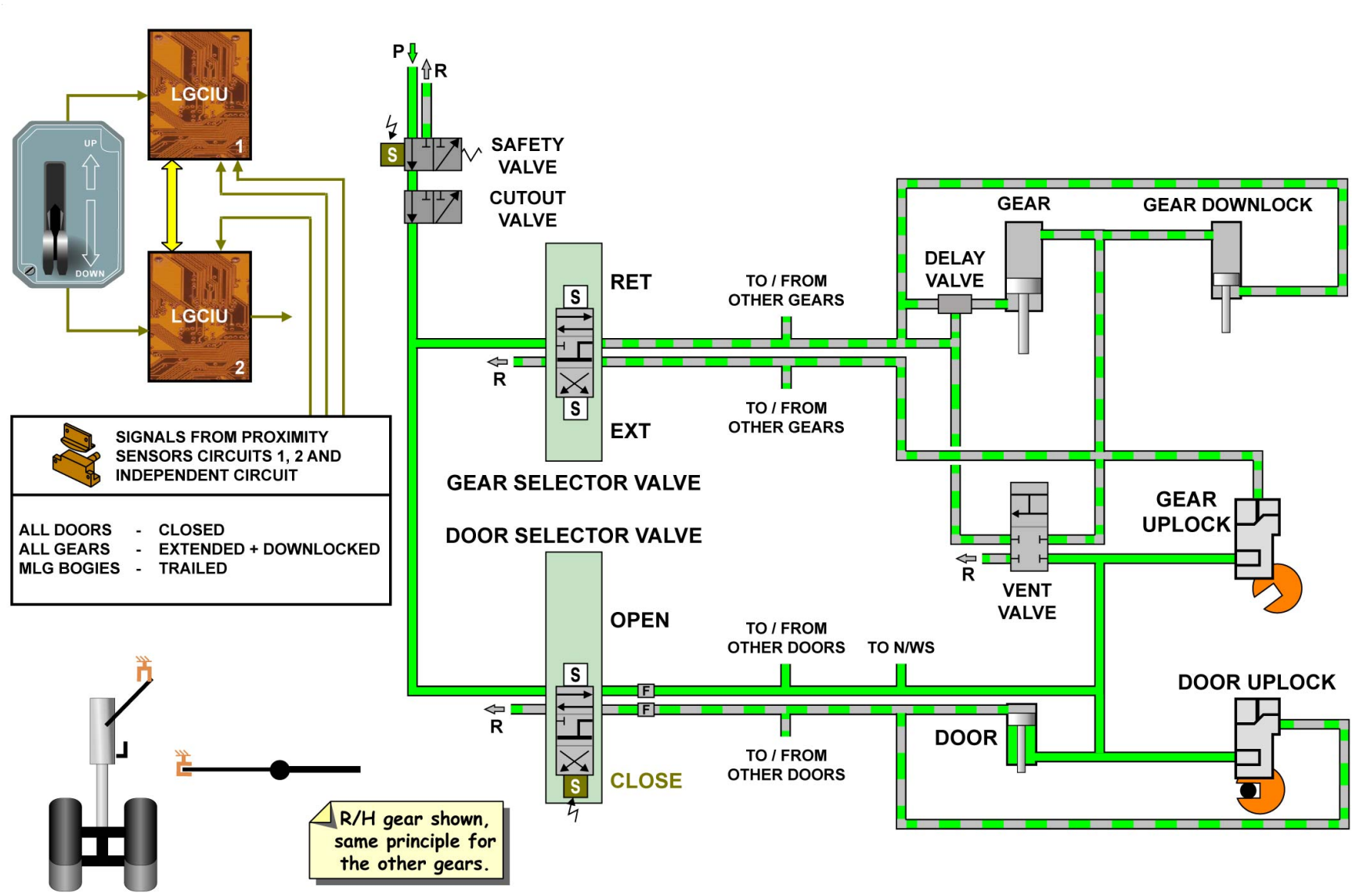

L/G EXTENSION AND RETRACTION SEQUENCES - GENERAL & L/G LOCKED DOWN, DOORS CLOSED

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G LOCKED DOWN, DOORS OPENING

UP selection is made. Notice that LGCIU 1 is now active. The first step is to open the L/G doors. The door selector valve DOOR OPEN solenoid is energized and the DOOR OPEN hydraulic lines are pressurized.All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.
The pressure in the DOOR OPEN hydraulic lines will release the door uplocks, and cause the doors to open.

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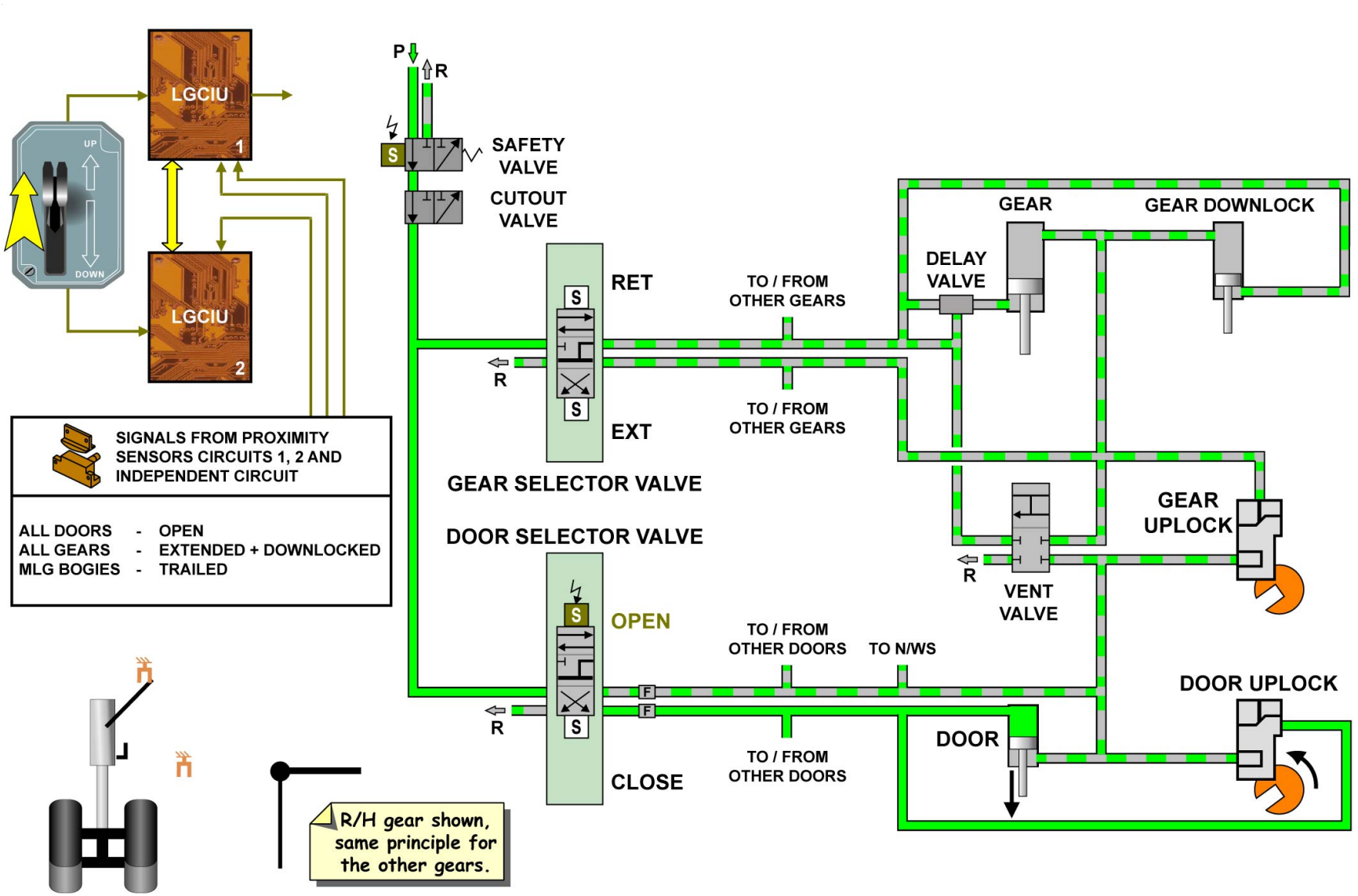

L/G EXTENSION AND RETRACTION SEQUENCES - L/G LOCKED DOWN, DOORS OPENING

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G RETRACTING, DOORS OPEN

The gear selector valve GEAR UP solenoid is energized, and the GEAR UP lines are pressurized .The landing gears are starting to retract. At this step, the delay valve retards the gear actuator from being supplied. This is to permit the gear downlock actuator to retract and thus to fold the side stay easily.
The door selector valve DOOR OPEN solenoid remains energized and the DOOR OPEN hydraulic lines are still pressurized.
All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.
The pressure in the DOOR OPEN hydraulic lines will keep the doors in the open position.. The pressure in the GEAR UP hydraulic lines will ensure the L/G downlocks are released. The L/G up-locks are maintained in the unlocked open position.

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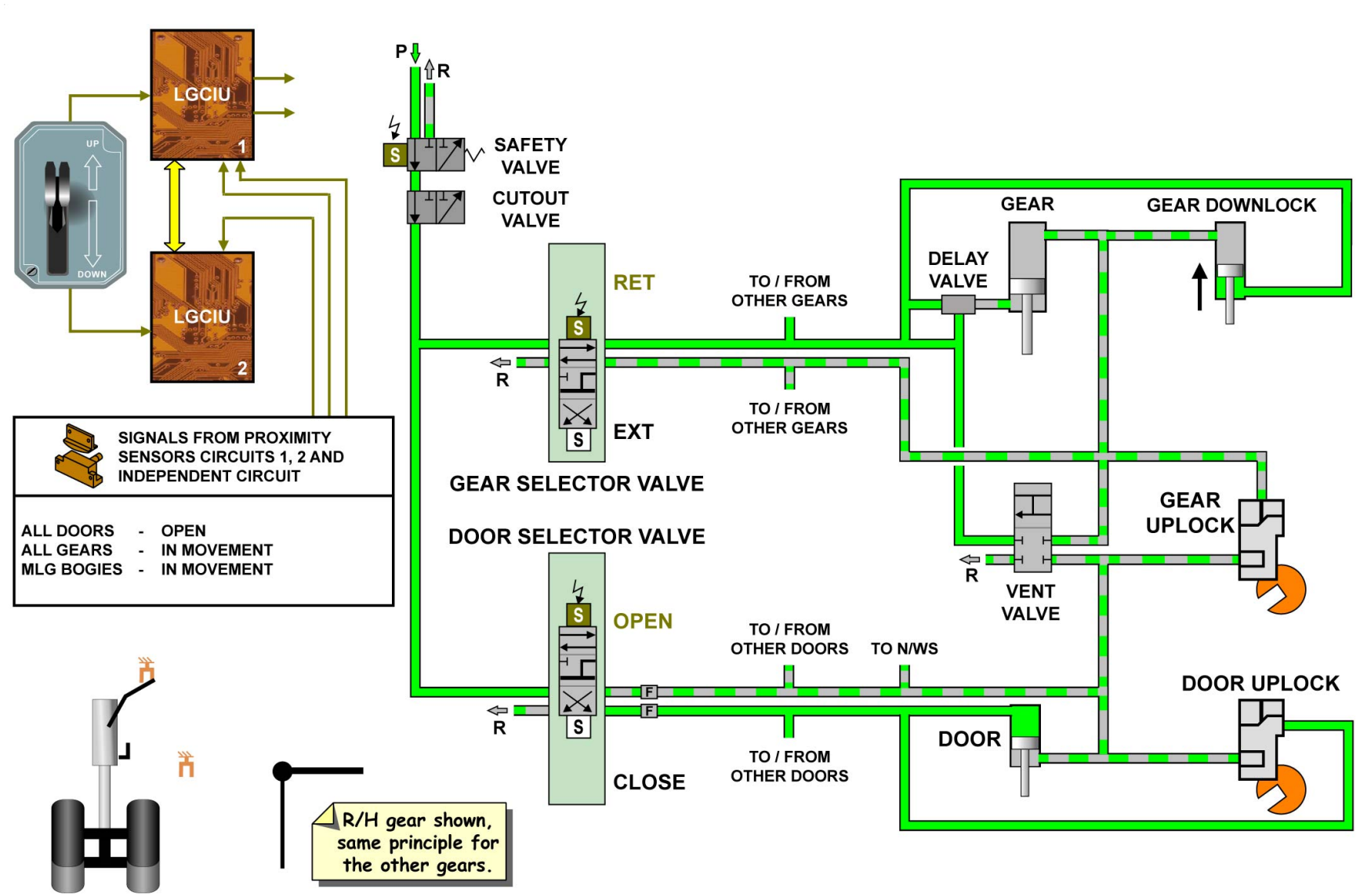

L/G EXTENSION AND RETRACTION SEQUENCES - L/G RETRACTING, DOORS OPEN

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

DOORS OPEN, AND L/G RETRACTS

The gear selector valve GEAR UP solenoid remains energized, and the GEAR UP lines are still pressurized. The door selector valve DOOR OPEN solenoid remains energized and the DOOR OPEN hydraulic lines are still pressurized. Each L/G has an uplock bearing which contacts the operating lever of the uplock assembly. This will cause mechanical engagement of the uplock hook.
All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.
The pressure in the DOOR OPEN hydraulic lines will keep the doors in the open position.

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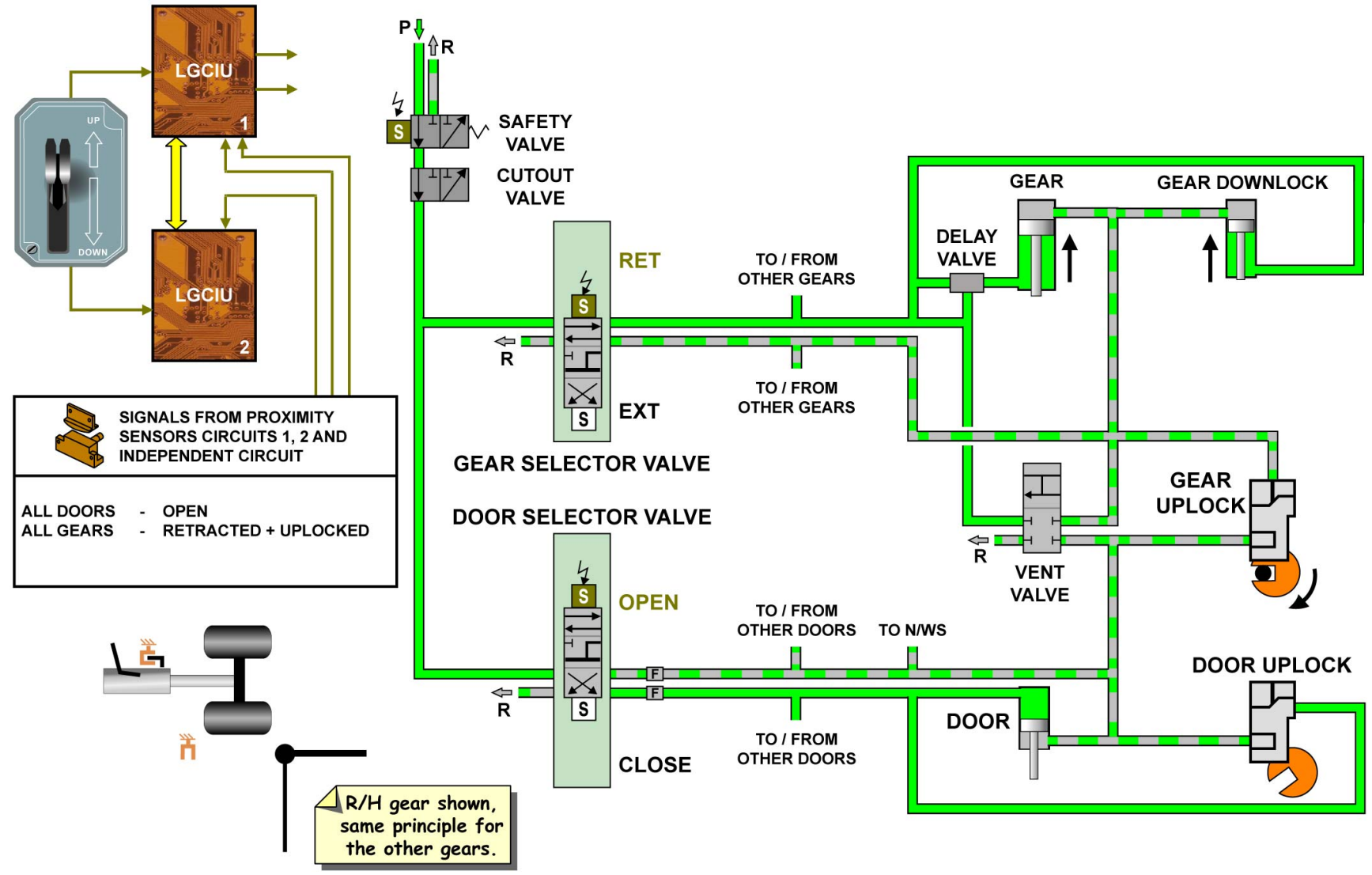

L/G EXTENSION AND RETRACTION SEQUENCES - DOORS OPEN, AND L/G RETRACTS

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G LOCKED UP, DOORS CLOSING

The door selector valve DOOR CLOSE solenoid is energized, the DOOR CLOSE hydraulic lines are pressurized and the doors move towards the closed position. The door uplock bearing makes contact with the operating lever of the uplock assembly. It causes a mechanical engagement of the door uplock hook.

The gear selector valve GEAR UP solenoid remains energized, and the GEAR UP lines remain pressurized.

All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.

The pressure in the GEAR UP hydraulic lines will ensure the L/G remains in the UP condition.

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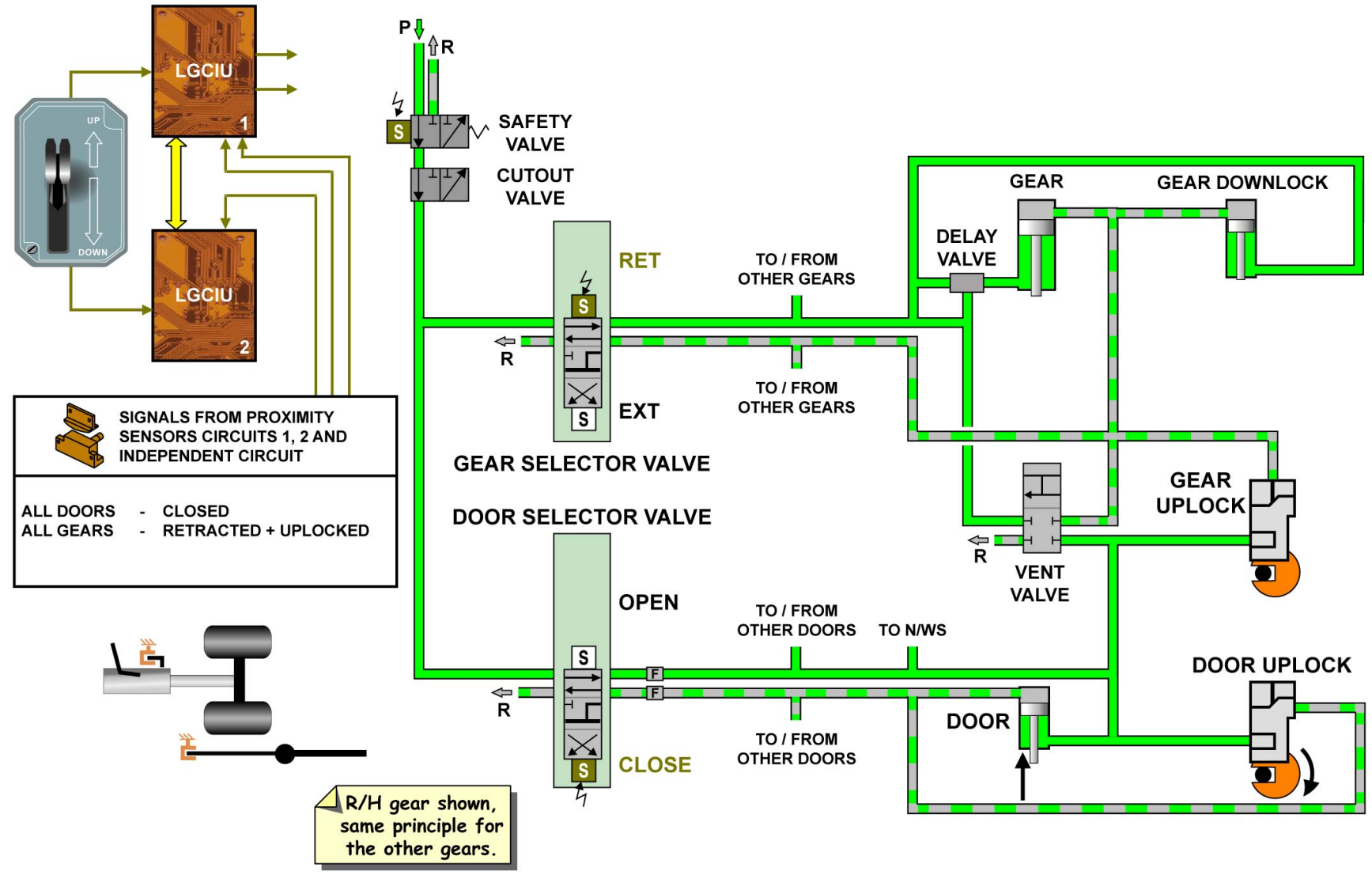

L/G EXTENSION AND RETRACTION SEQUENCES - L/G LOCKED UP, DOORS CLOSING

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G LOCKED UP, DOORS CLOSED

The door selector valve DOOR CLOSE solenoid remains energized and the DOOR CLOSE hydraulic lines remain pressurized.
All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.

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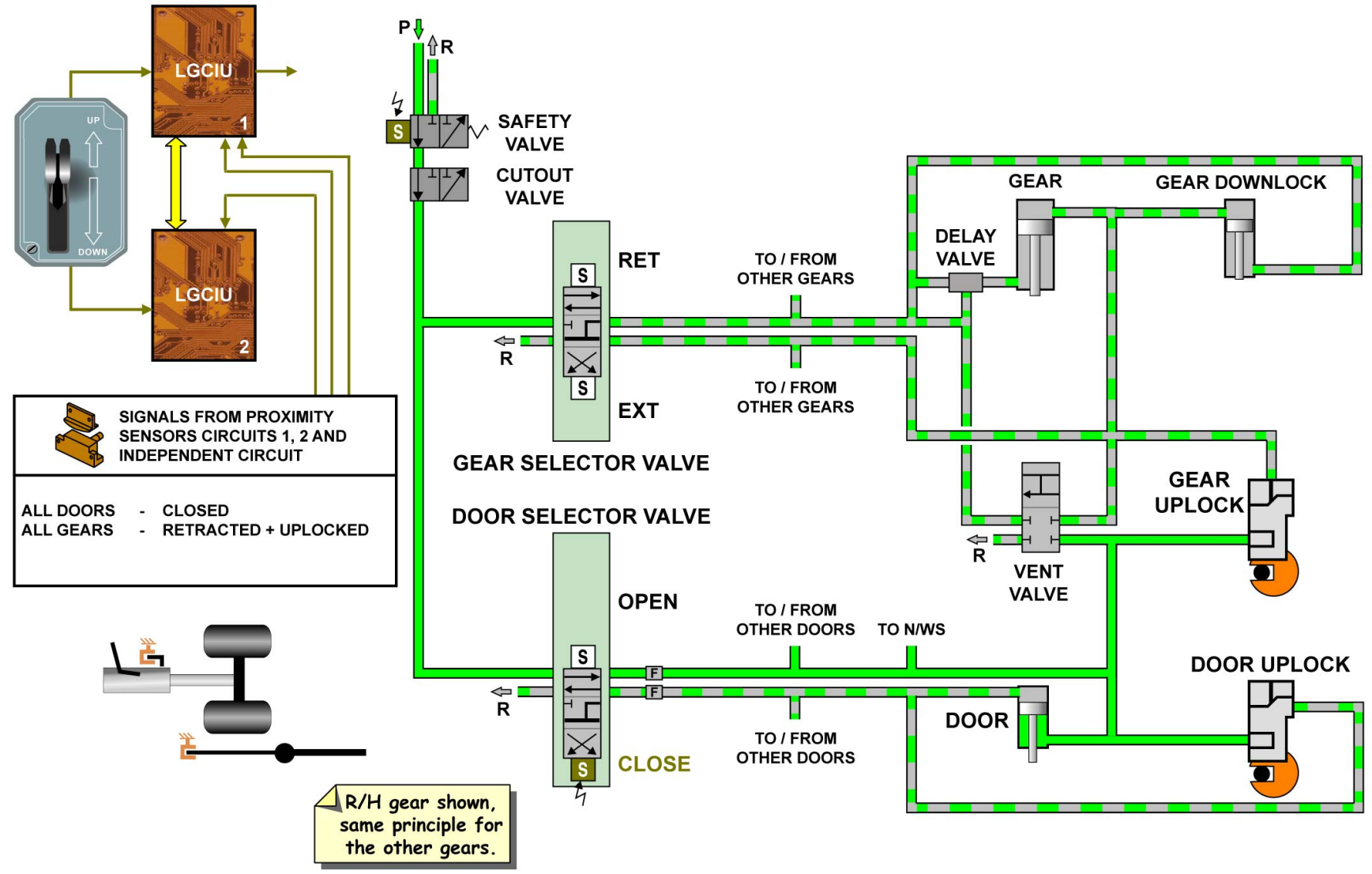

L/G EXTENSION AND RETRACTION SEQUENCES - L/G LOCKED UP, DOORS CLOSED

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

ABOVE 280 KTS

The pressure in the DOOR CLOSE hydraulic lines keeps the doors in the closed position. If the A/C speed exceeds 280 Kts, the green supply is isolated by the safety valve, and only the door uplocks ensure the doors remain in the closed position.

NOTE: The safety valve operation is possible thanks to the ADIRUs speed signal. On the ground, if the ADIRus are not aligned, the safety valve solenoid valve is energized OPEN by the LGCIUs or the Electrical Ground Power availability. In flight, above 280 knots, the safety valve solenoid is de-energized CLOSED.

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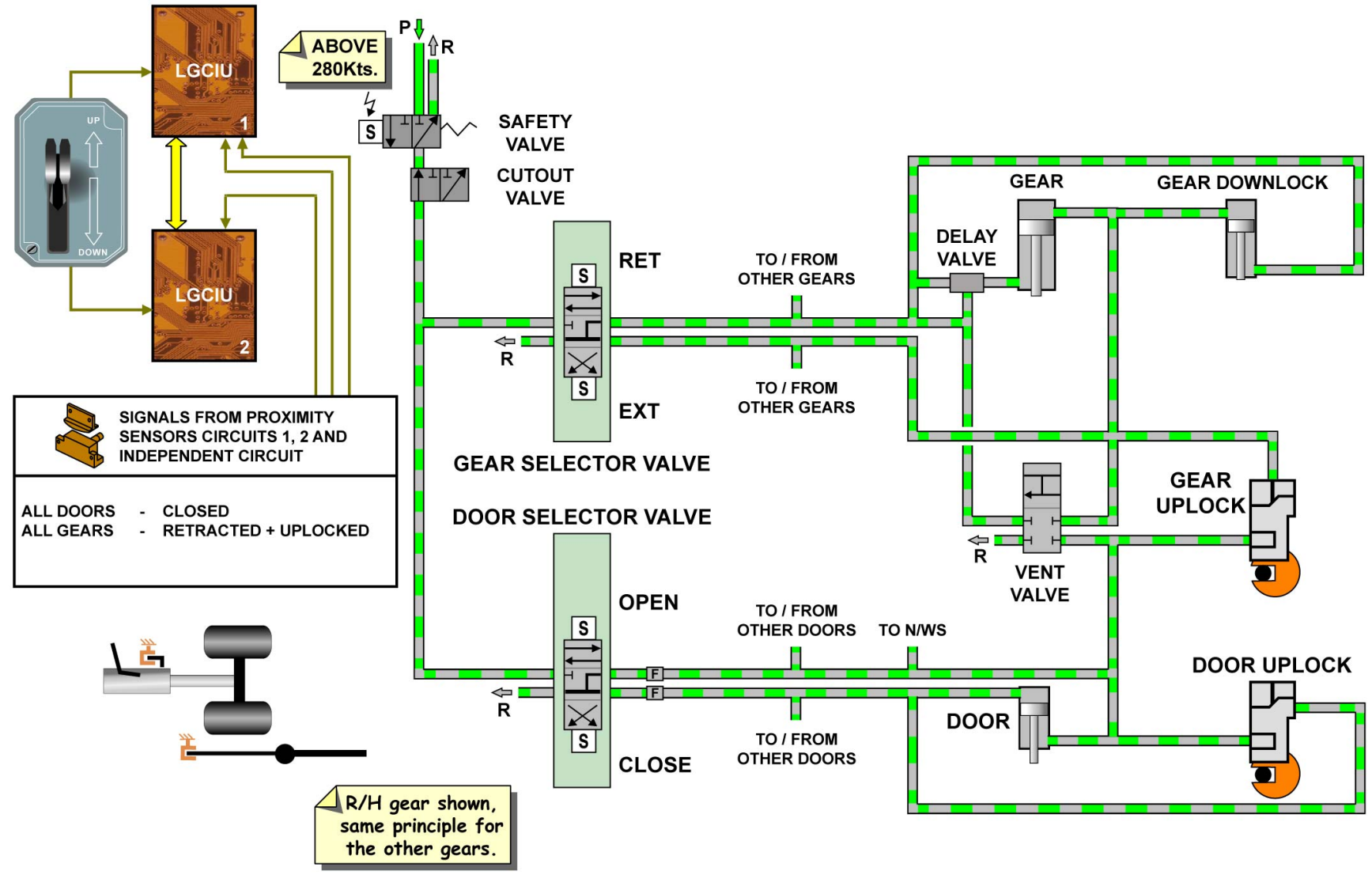

L/G EXTENSION AND RETRACTION SEQUENCES - ABOVE 280 KTS

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G LOCKED UP, DOORS OPENING

Below 280 knots, when a DOWN selection is made, the safety valve solenoid is re-energized OPEN. The door selector valve DOOR OPEN solenoid is energized and the DOOR OPEN hydraulic lines are pressurized. All other solenoids de-energized.
All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.
The pressure in the DOOR OPEN hydraulic lines will unlock the door uplocks and open the doors.

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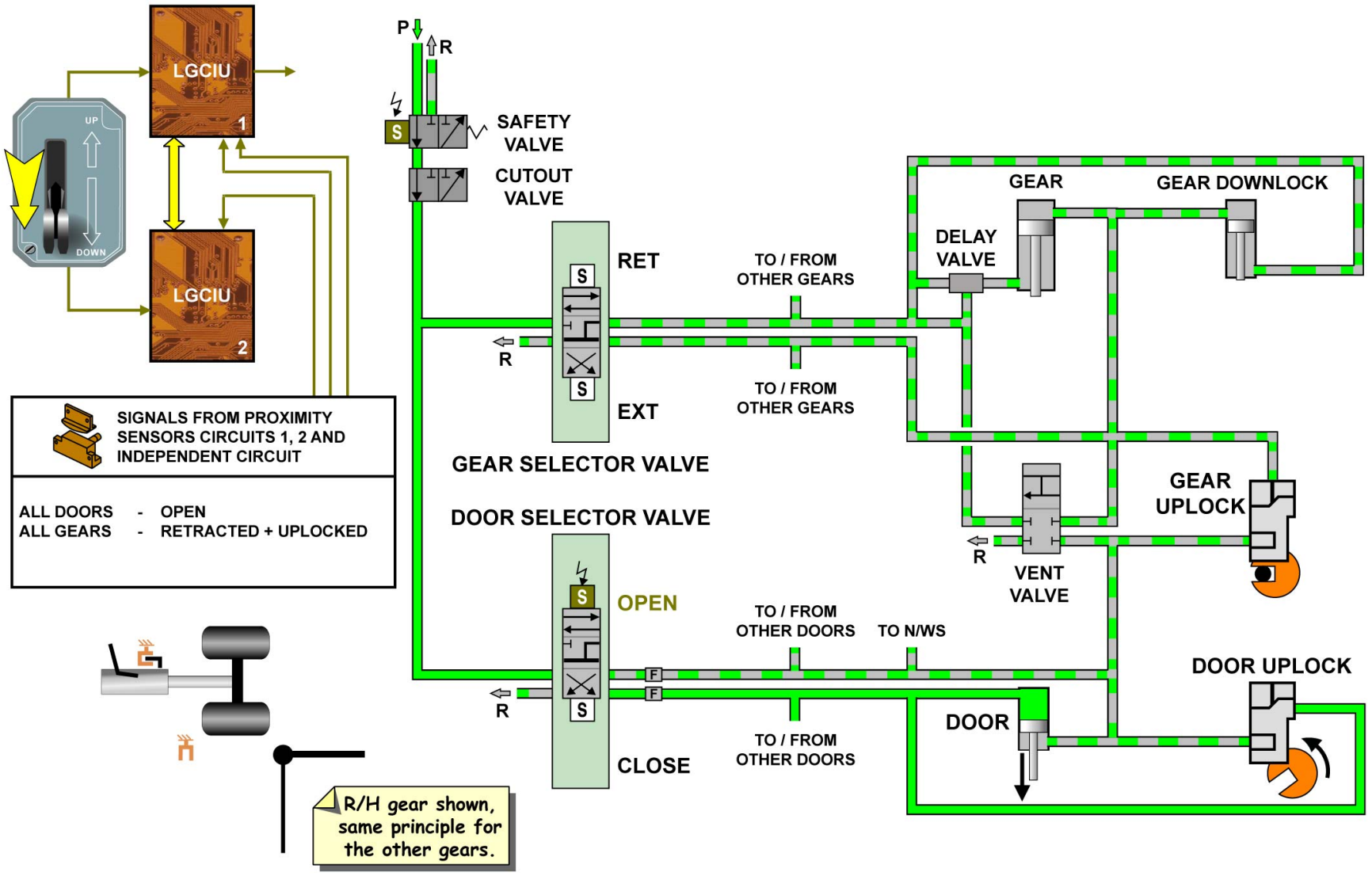

L/G EXTENSION AND RETRACTION SEQUENCES - L/G LOCKED UP, DOORS OPENING

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

DOORS OPEN, L/G EXTENDS

Once all doors are sensed fully opened, the LGCIU carries on to extend the gear. The gear selector valve GEAR DOWN solenoid is energized, and the GEAR DOWN lines are pressurized.
The door selector valve DOOR OPEN solenoid remains energized and the DOOR OPEN hydraulic line is kept pressurized.
All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.
The pressure in the DOOR OPEN hydraulic lines keeps the doors open.
The pressure in the GEAR DOWN lines will release the L/G uplocks and cause the L/G actuators to extend.

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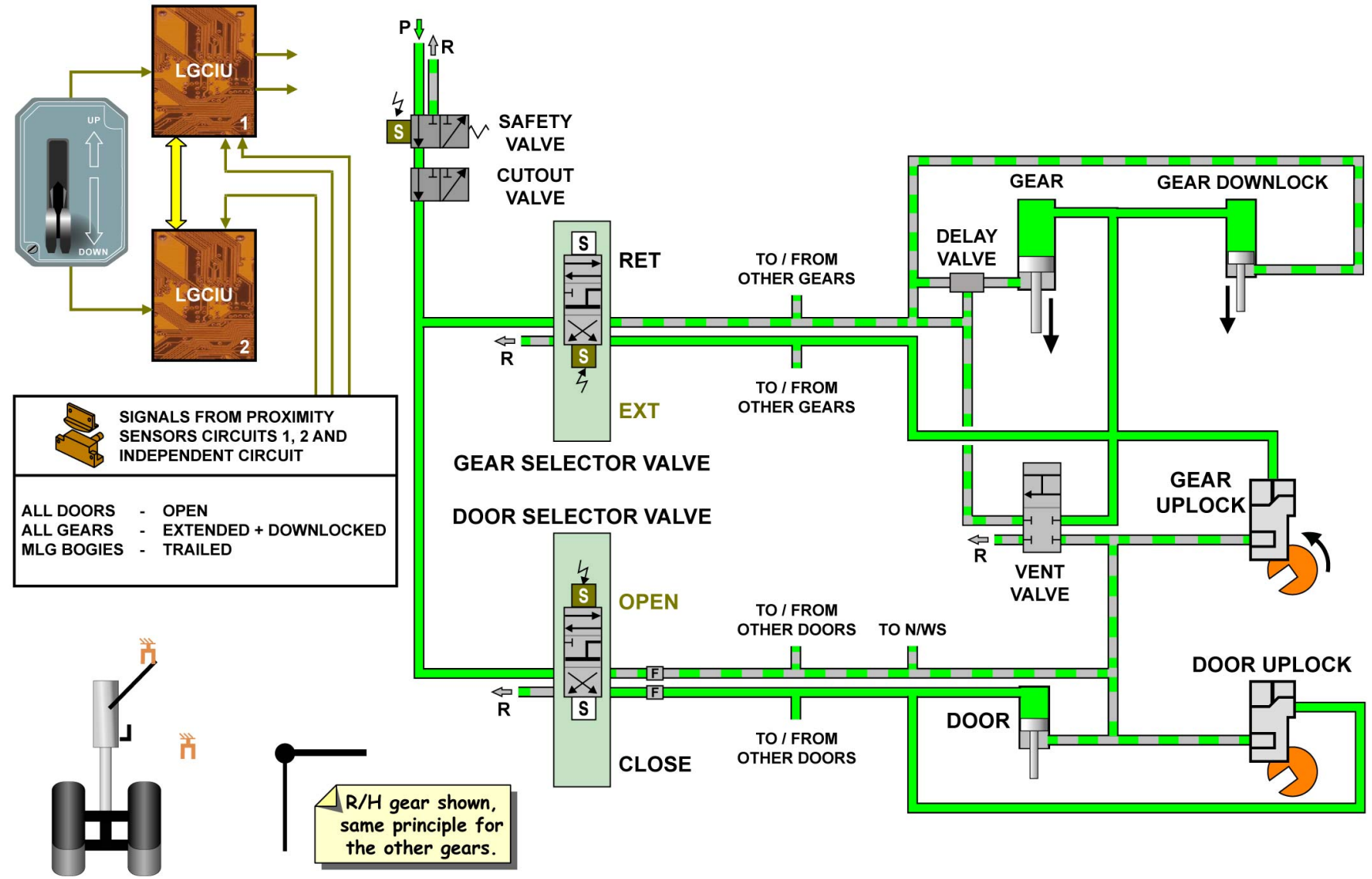

L/G EXTENSION AND RETRACTION SEQUENCES - DOORS OPEN, L/G EXTENDS

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G LOCKED DOWN, DOORS CLOSING

The door selector valve DOOR CLOSE solenoid is energized and the DOOR CLOSE hydraulic lines are pressurized. The door uplock bearing makes contact with the operating lever of the uplock assembly. It causes a mechanical engagement of the door uplock hook. The gear selector valve GEAR DOWN solenoid remains energized, and the GEAR DOWN lines remain pressurized until the doors are fully closed. All other solenoids de-energized.

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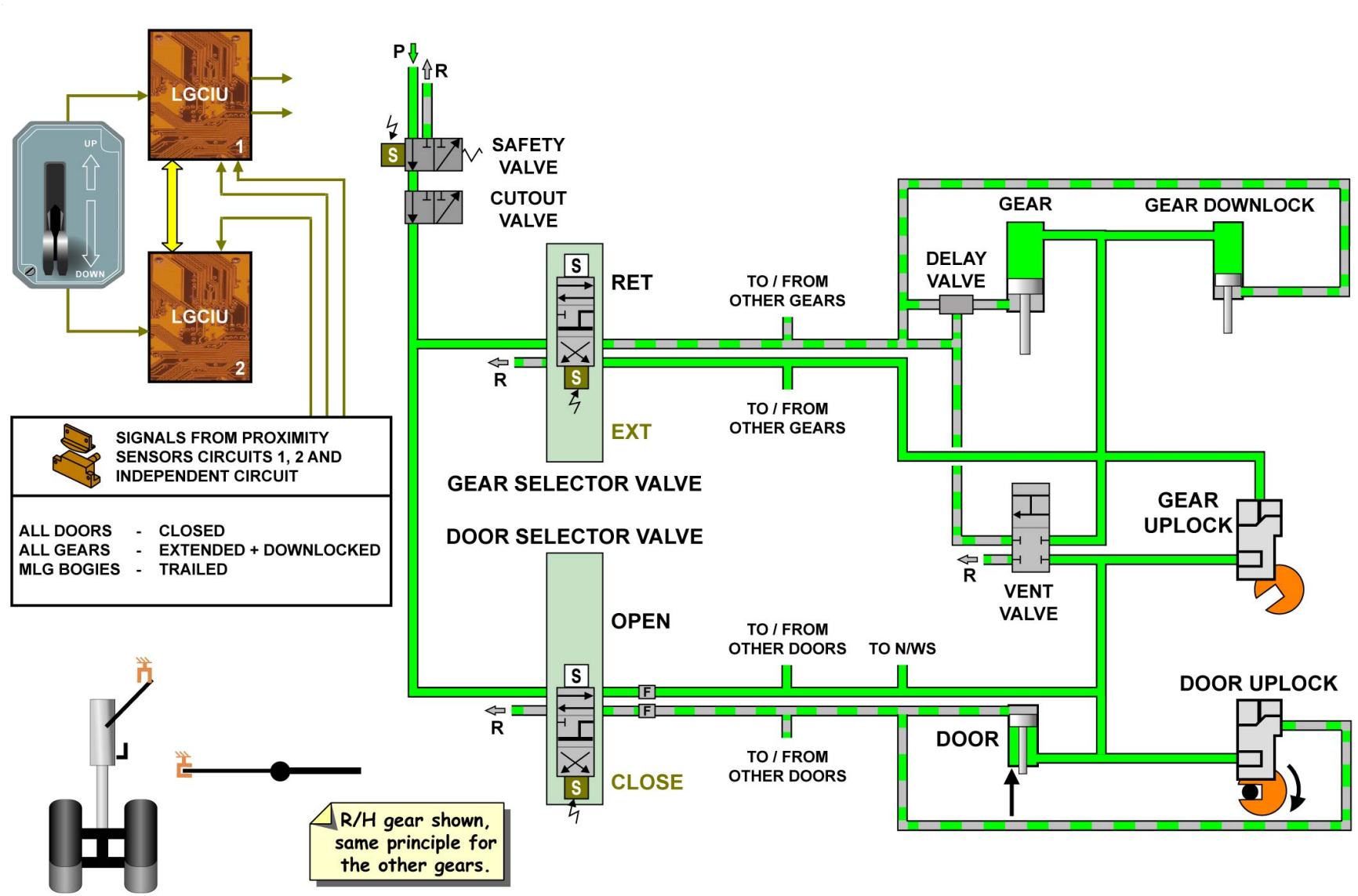

L/G EXTENSION AND RETRACTION SEQUENCES - L/G LOCKED DOWN, DOORS CLOSING

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NORMAL EXTENSION AND RETRACTION D/O (3)

L/G EXTENSION AND RETRACTION SEQUENCES (continued)

L/G LOCKED DOWN

Pressure in the DOOR CLOSED lines will maintain the doors in the closed position. The gear downlock remains in the overcentred locked down condition. All other solenoids are de-energized, and their corresponding hydraulic lines are depressurized.

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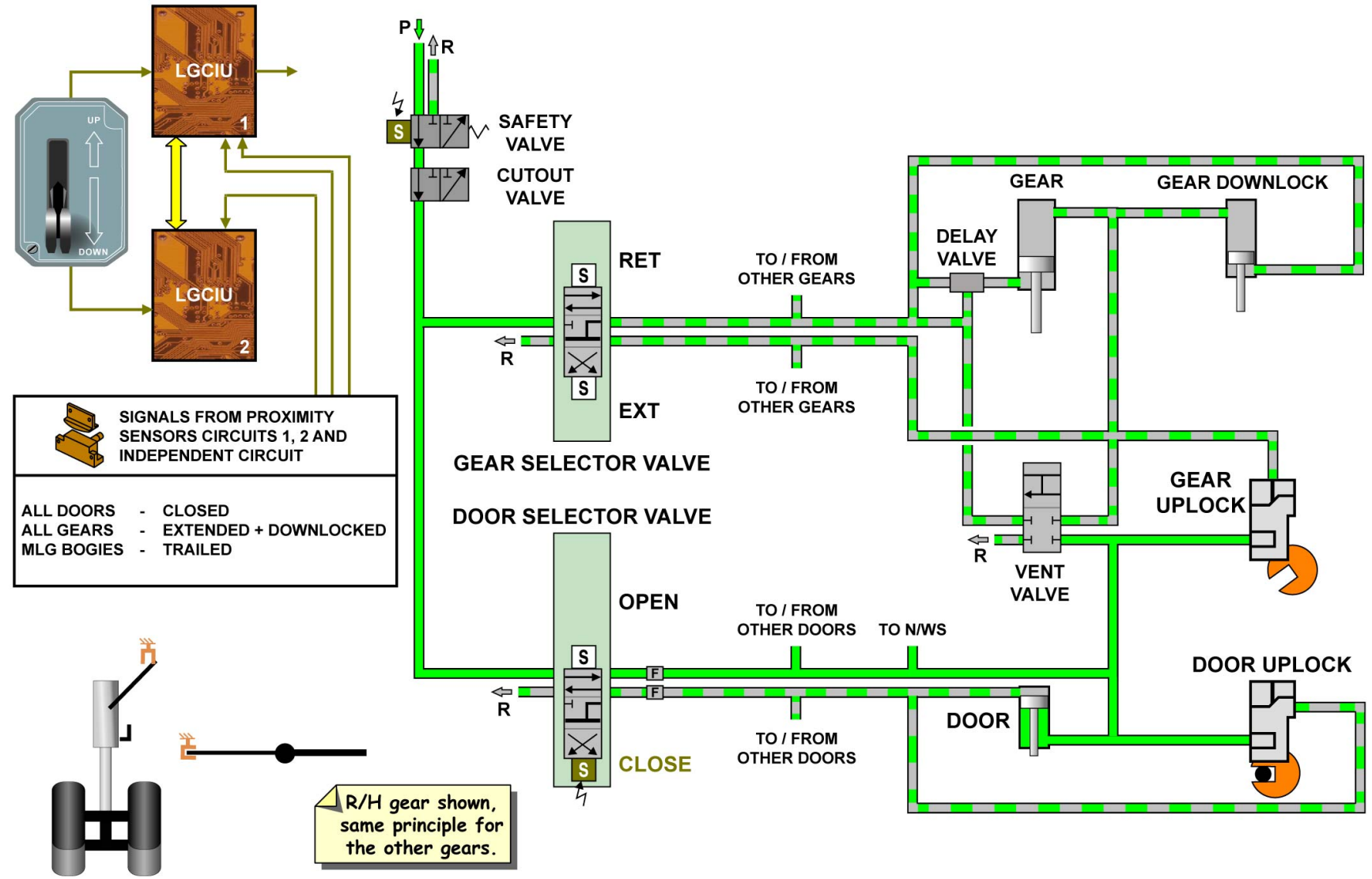

L/G EXTENSION AND RETRACTION SEQUENCES - L/G LOCKED DOWN

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FREE FALL EXTENSION D/O (3)

ELECTRICAL SYSTEM

The electrical actuators operate the free fall extension system. They release the MLG and the NLG door and gear uplocks through the mechanical system.
The A/C batteries supply 28 VDC through two hot bus bars. There are two independent circuits between the bus bars and the free-fall actuators. Usually the circuits are energized at the same time, but each circuit will operate the free-fall electrical actuators (at half speed) if the other circuit is not available.
Each circuit has a lock-toggle type switch, each switch operates a motor in the L/G free-fall electrical actuator. A ganging bar connects the two switches together.
It is possible to move the ganging bar away from the switches (during maintenance) and operate the switches independently.

MLG MECHANICAL SYSTEM

In the right MLG bay a linkage connects the free-fall actuator to the cut-out valve.
The linkage also connects, through the cut-out valve to the vent valve, the MLG uplock and the MLG door uplock. When the output shaft of the free-fall actuator turns, it moves the linkage, which operates the valves and opens the door and gear uplocks.
The left MLG configuration is almost the same as the right MLG, but does not include a cut-out valve.

NLG MECHANICAL SYSTEM

In the NLG bay, a linkage connects the free-fall actuator to the vent valve and the NLG uplock. A flexible cable connects the free-fall actuator to the NLG door uplock. When the output shaft of the free-fall actuator turns, it moves the linkages and flexible cable, which operates the vent valve and opens the door and gear uplocks.

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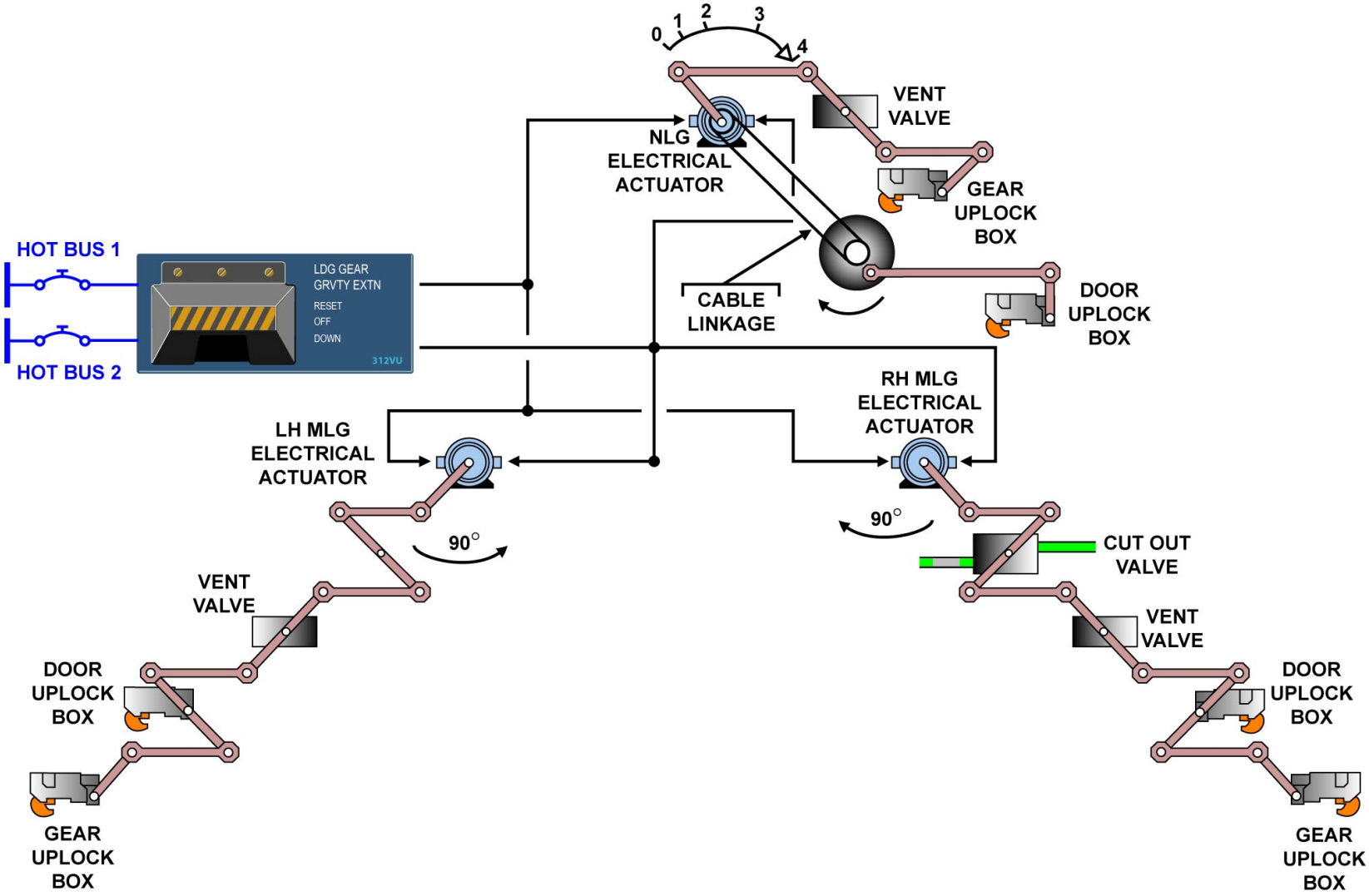

ELECTRICAL SYSTEM ... NLG MECHANICAL SYSTEM

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FREE FALL EXTENSION D/O (3)

OPERATION

-In this scenario, we assume a dual LGCIU failure.
Landing gear lever is set to down. This is to avoid nuisance messages.

CAUTION: The free fall extension system can be operated with the A/C not electrically powered (the hot buses supply the electrical actuators). Normally both motors are energized together and the actuators reach full travel in approximately ten seconds.

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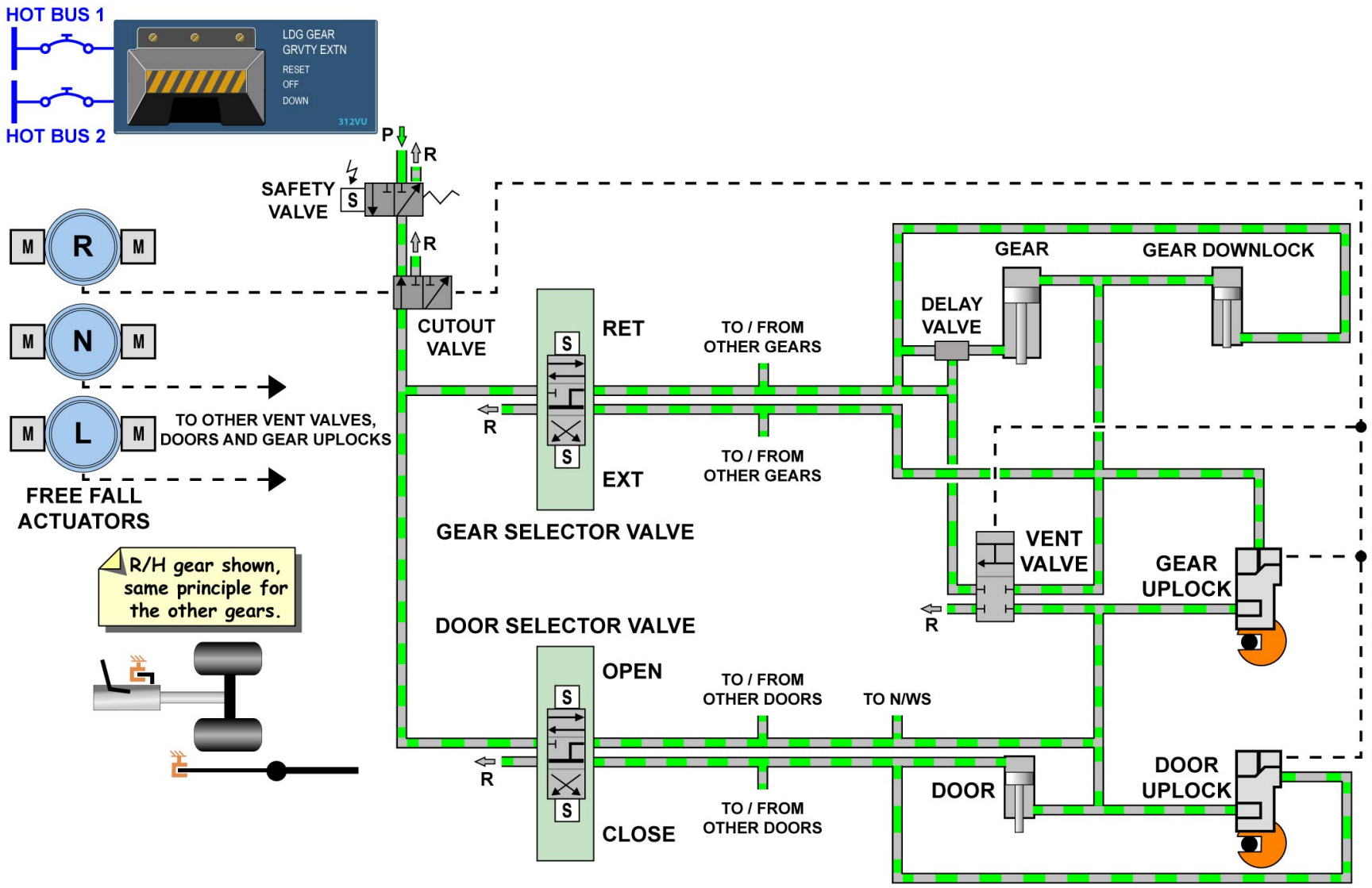

OPERATION

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FREE FALL EXTENSION D/O (3)

OPERATION (continued)

RELEASE

When the LDG GEAR free-fall switches are set to DOWN, the electrical actuators are energized. The actuators turn the output shaft and move the mechanical linkage to operate the hydraulic and mechanical components in sequence as follows:
- (1) the cut-out valve operates. This isolates the whole L/G system from the green hydraulic supply,
- (2) the vent valves operate, connecting all gear and door actuators to the green hydraulic system return,
- (3) the door uplock boxes operate, releasing the hook,
- (4) the gear uplock boxes operate and the gear falls down by gravity.

During this sequence, the electrical actuators operate the output shaft from the 0 degree position to the 90 degrees position.

WARNING: After a free fall landing, the first maintenance action is to install gear safety pins and set all the ground opening handles down.

RESET

When RESET is selected, the actuators turn back to their initial positions and automatically set the system back to the normal extension and retraction mode. The actuator output shaft moves by 90 degrees in reverse direction.
Upon completion of the reset, the hydraulic pressure is restored. Doors are pressurized open while the L/G is retracted and then the doors close. The switches are set to OFF after the system goes back to the normal extension and retraction mode.

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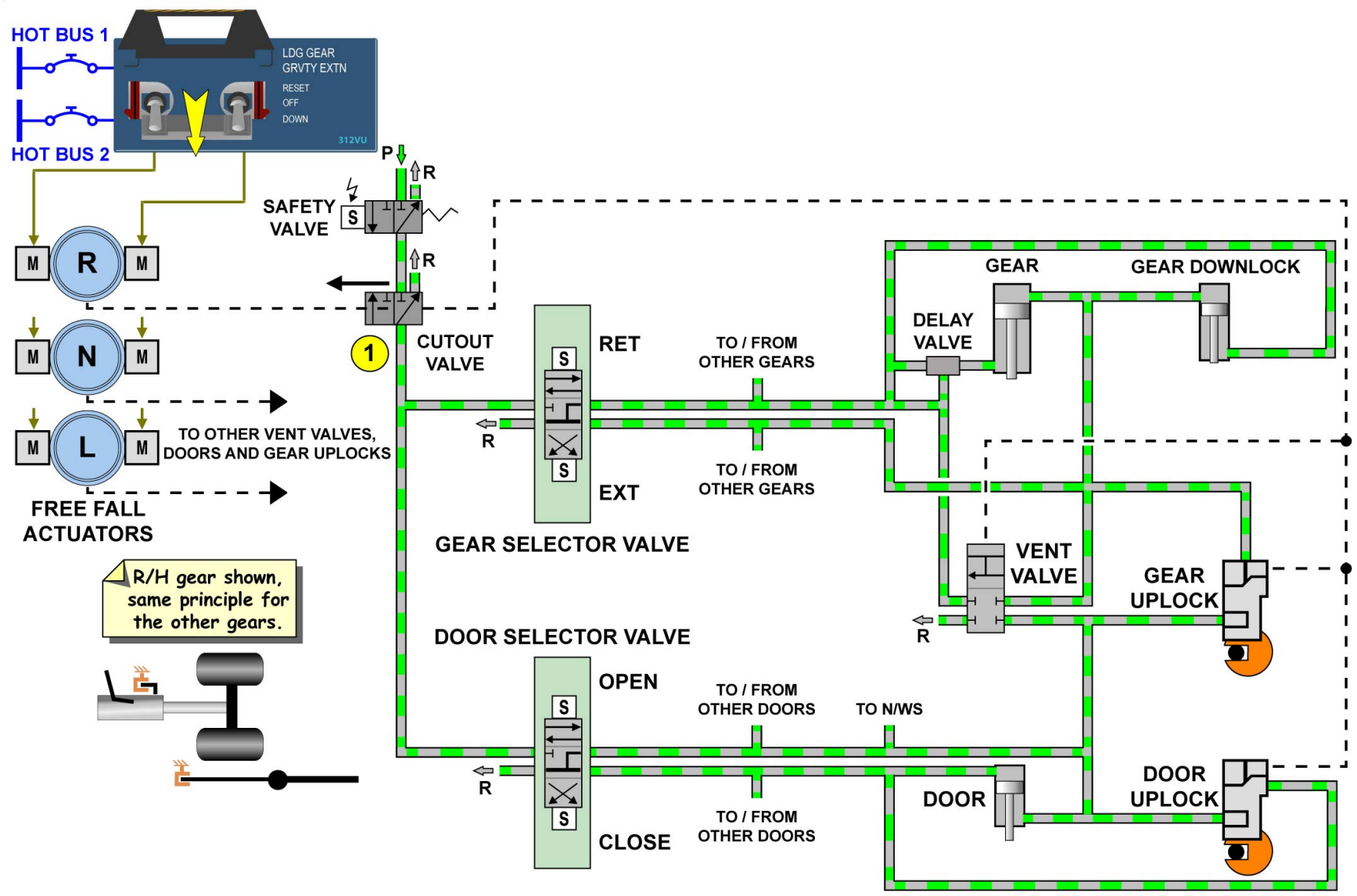

OPERATION - RELEASE & RESET

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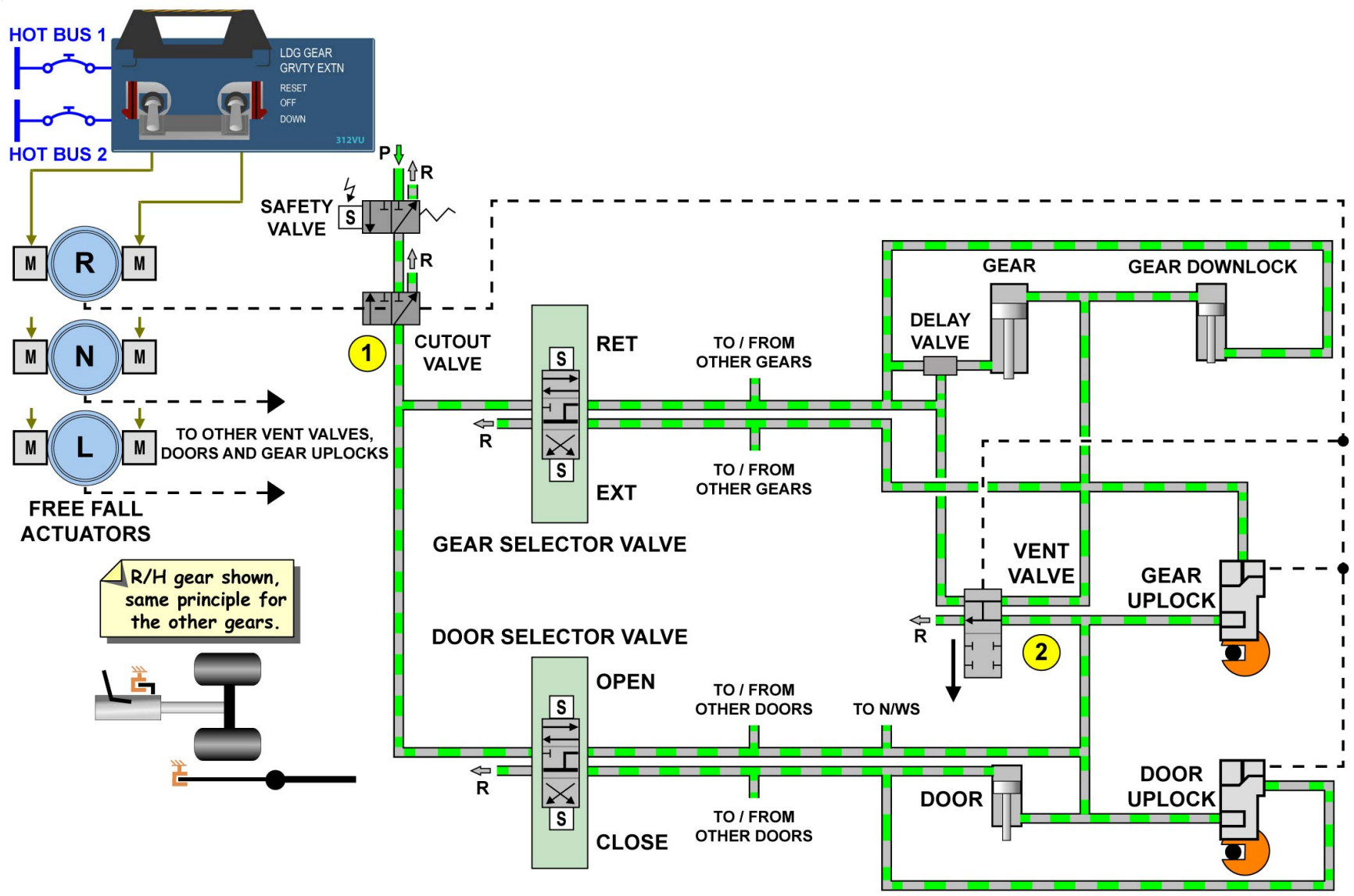

OPERATION - RELEASE & RESET

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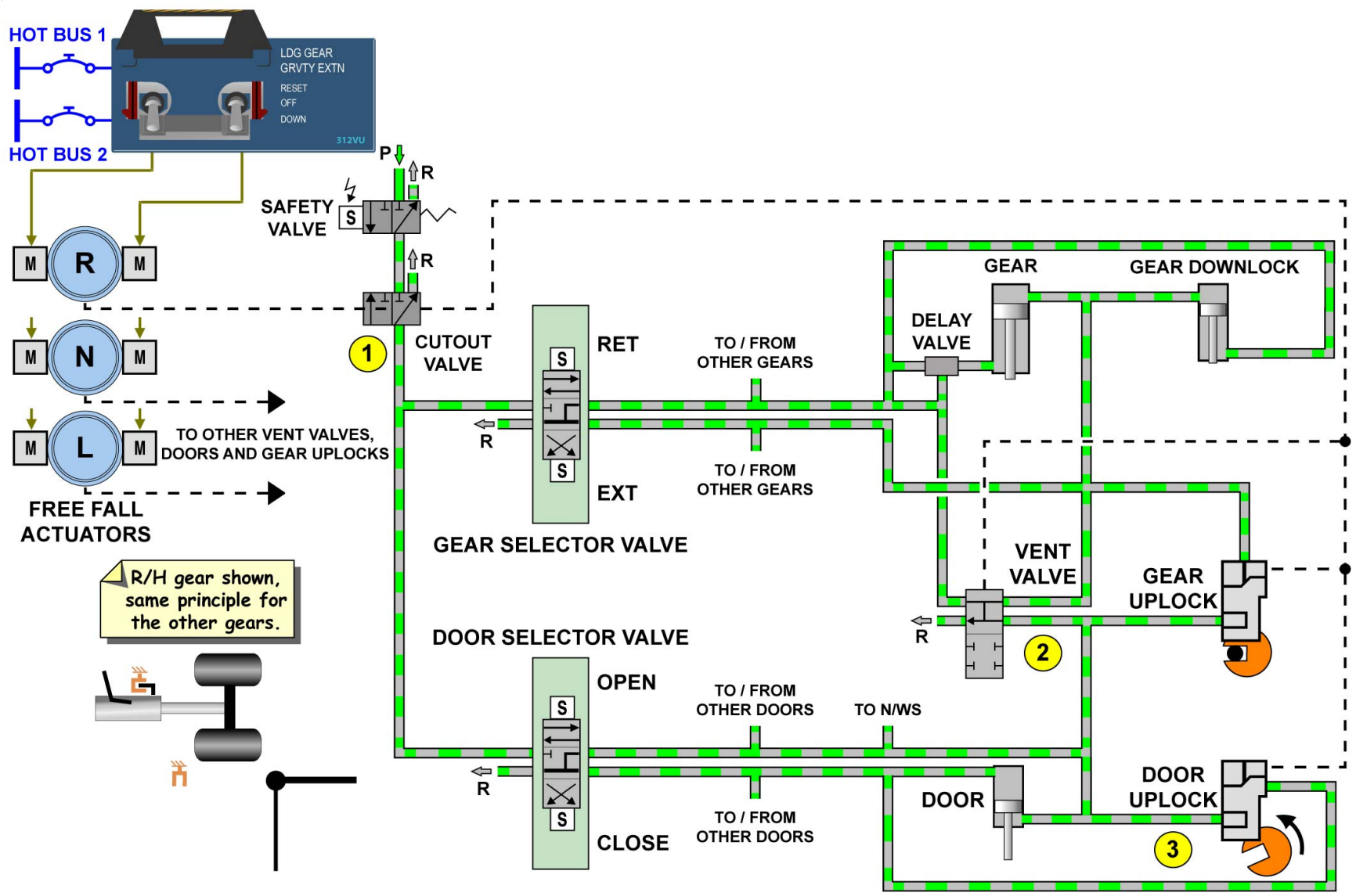

OPERATION - RELEASE & RESET

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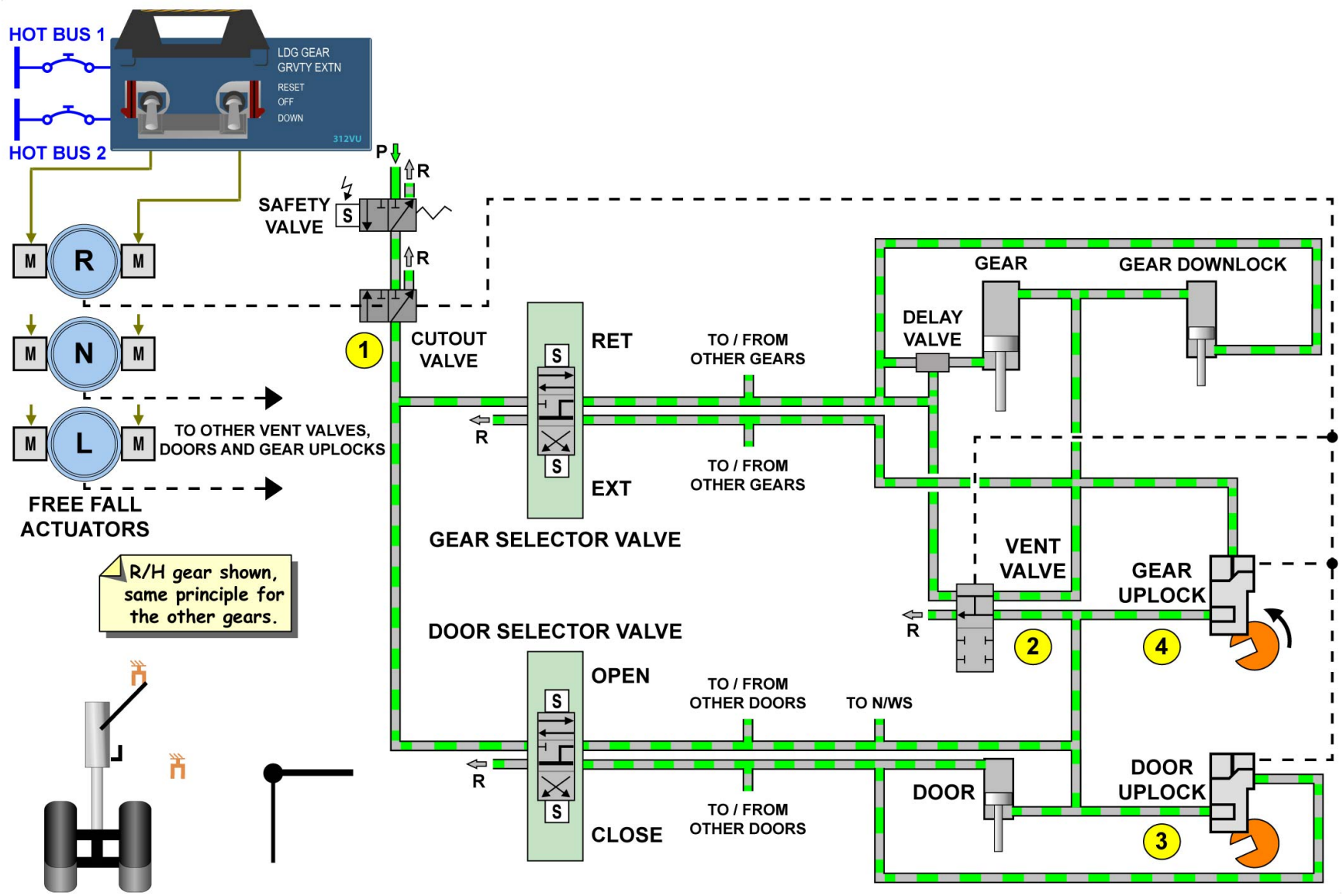

OPERATION - RELEASE & RESET

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DOOR GROUND OPENING D/O (3)

DESCRIPTION

MAIN LANDING GEAR

The MLG door ground-opening control handle is accessible through a panel located at the center fuselage, forward the MLG door. This location gives the operator a safe position and a clear view of the door travel. The control handle is connected, through a push-pull cable, to a layshaft at the outboard side of MLG bay.
Each door has a door ground opening mechanism that enables door opening for maintenance. The mechanism has these following primary components:
- a control handle,
- a bi-stable mechanism,
- a bypass valve,
- a release mechanism in the door uplock.

The control handle has two lockable positions. When it is set to the DOOR OPEN position, it causes the mechanical system to:
- operate the door bypass valve,
- release the door from its uplock.

The bi-stable mechanism is attached to the operating shaft of the bypass valve. It makes sure that the bypass valve and the control handle can only stay in the doors FULLY OPEN position or the doors FULLY CLOSED position.

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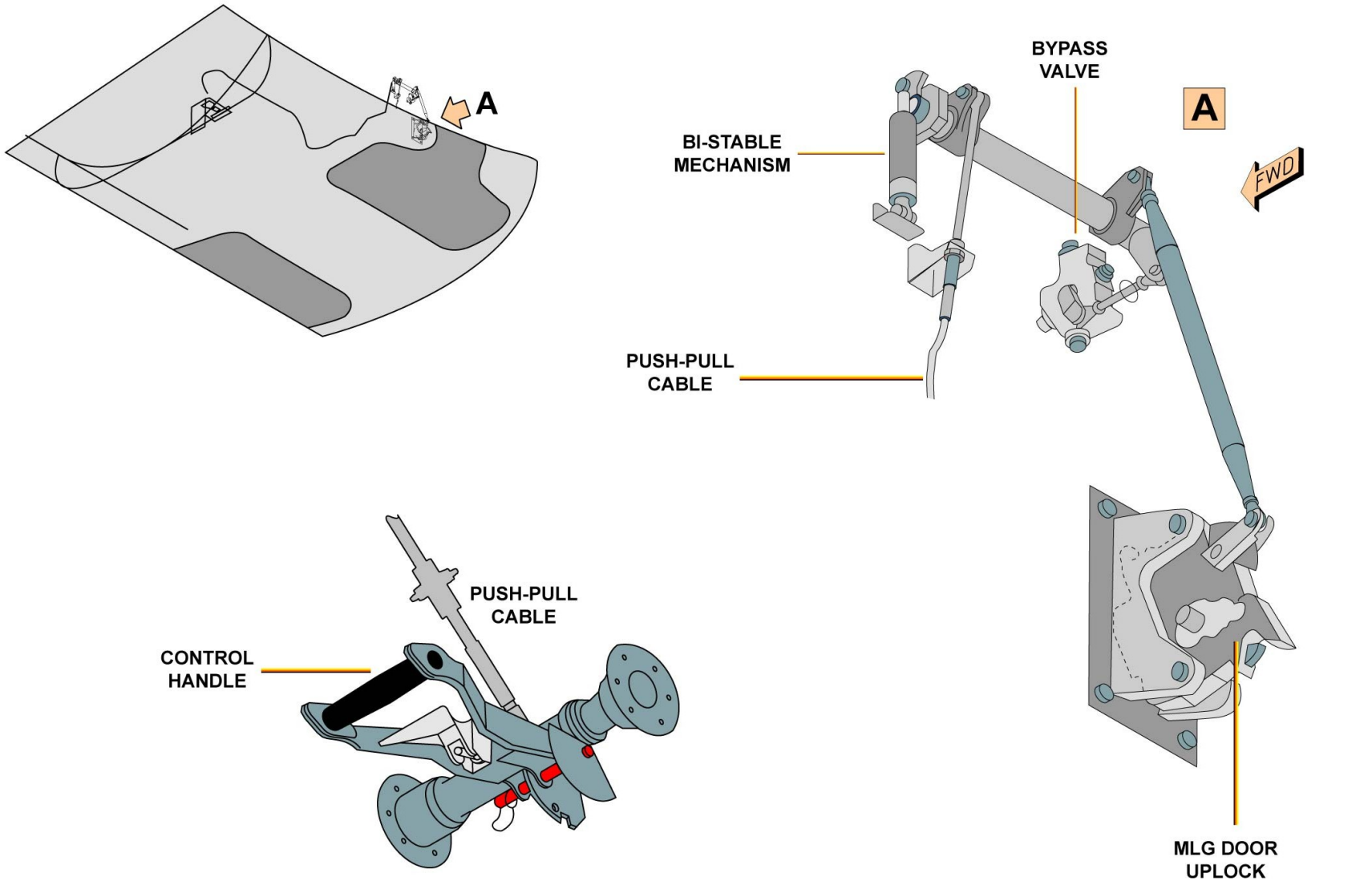

DESCRIPTION - MAIN LANDING GEAR

DOOR GROUND OPENING D/O (3)

DESCRIPTION (continued)

NOSE LANDING GEAR

The NLG door ground-opening handle is installed on a housing on the aft bulkhead of the NLG bay. This location gives the operator a safe position and a clear view of the door range of travel. The control handle is connected, through a bell-crank and rod to the bypass valve. It is also connected through a spindle and push-pull cable to the NLG door uplock.

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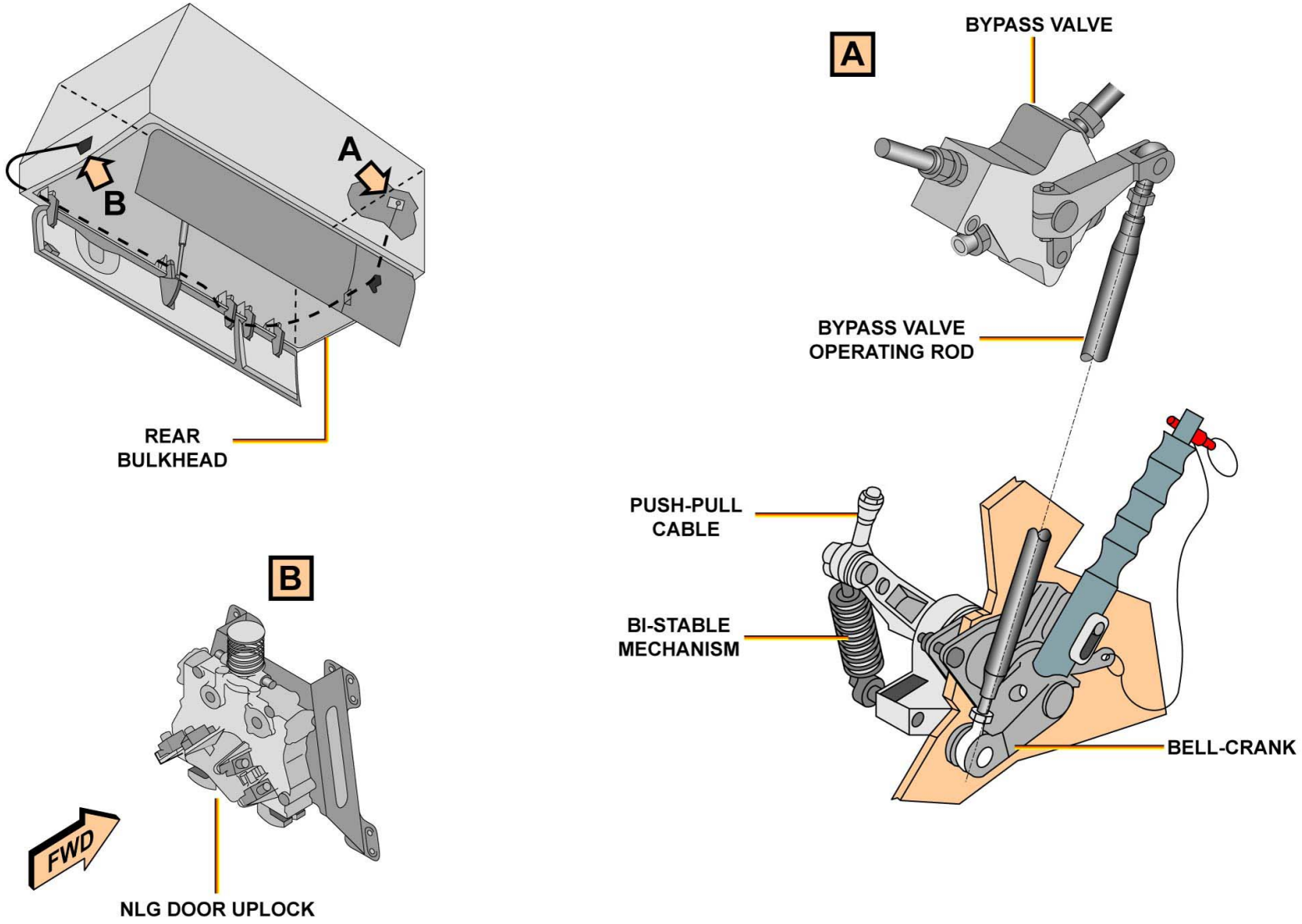

DESCRIPTION - NOSE LANDING GEAR

DOOR GROUND OPENING D/O (3)

MAIN DOOR OPENING SCHEMATIC

As the principle is the same, the MLG door ground-opening mechanism has been chosen as example. When the door ground-opening mechanism is used, the control handle is connected through a push-pull cable and different components to a door uplock. During normal operation of the extension and retraction system, the hydraulic fluid goes through the bypass valve (between port B and C) to the door actuator.
The initial movement of the handle causes the bypass valve to isolate the door actuator from the door-close hydraulic line and interconnects the two chambers of the door actuator. Further movement of the handle operates the release mechanism in the door uplock, which lets the main door opening by gravity. The bypass valve includes a baulk device. This device prevents movement of the door ground-opening handle to the door close position unless the green hydraulic system is pressurized.

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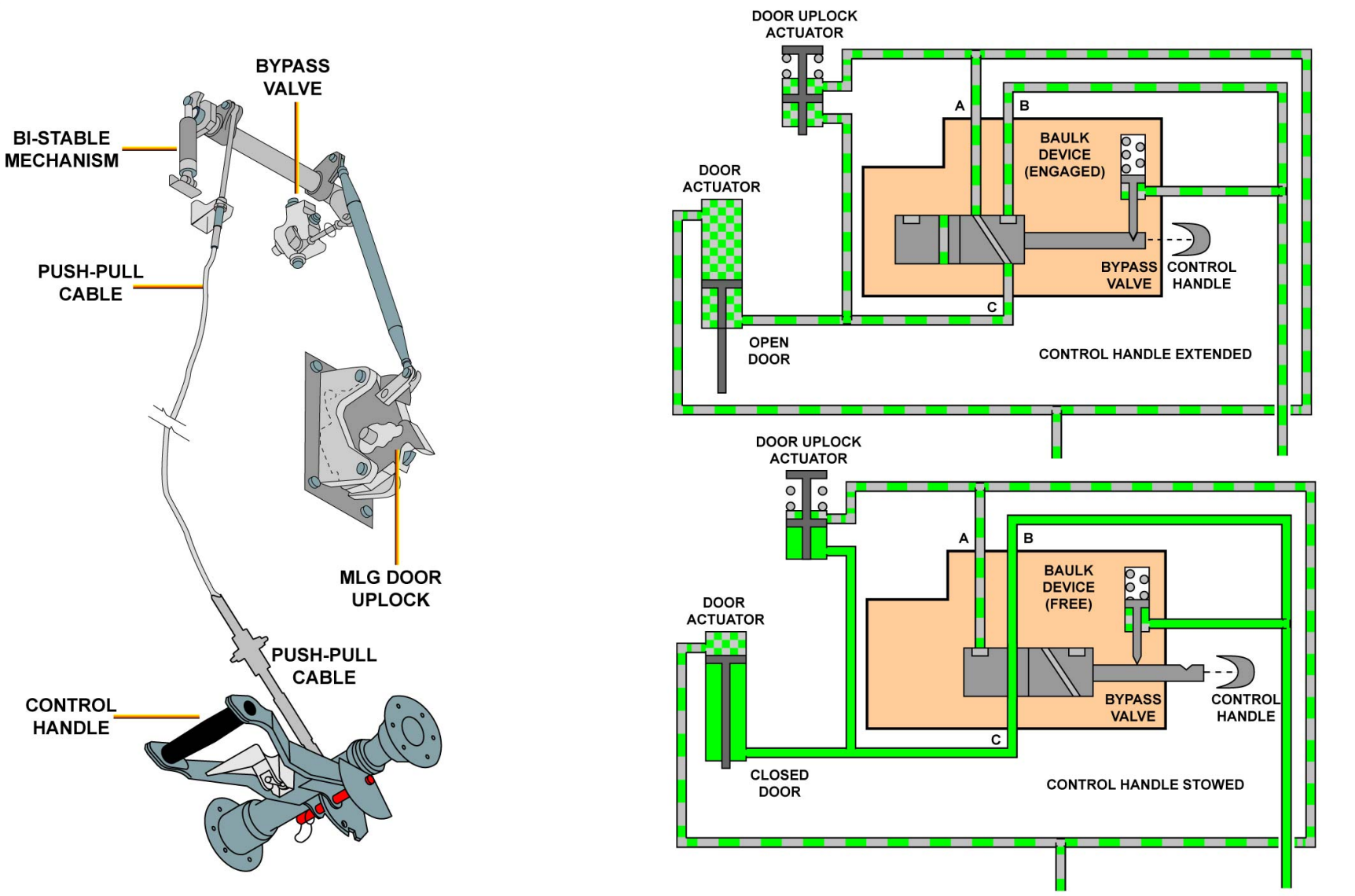

MAIN DOOR OPENING SCHEMATIC

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NORMAL BRAKING D/O (3)

SYSTEM ARCHITECTURE

This graphic presents the entire braking system architecture.

GENERAL

In the normal brake system, hydraulic power is supplied from the green system to actuate one set of pistons on each brake unit. The normal braking system is electrically signaled by the Brake and Steering Control Unit (BSCU) and fulfills:
- manual braking mode via the brake pedal deflection,
- automatic braking mode (pre-set selection),
- in-flight braking mode (automatic braking of the main wheels during landing gear retraction),
- anti-skid protection.

DESCRIPTION

The normal braking system is composed of different components that will be described.

BRAKE PEDAL ASSEMBLIES

The brake pedal assemblies, at each pilot position, are mechanically interconnected. They transmit the manual braking inputs through the brake pedal transmitter unit to the BSCU.

L/G PANEL

The auto brake rotary selector switch provides 3 auto brake modes intended for use during landing (LO, MED and HI).

BSCU

The dual channel BSCU controls and monitors the normal manual and automatic braking system with the anti-skid protection. It converts data for display and warnings, does various tests and supplies information to the Central Maintenance System (CMS).

NORM BRK SELECTOR VALVE

The Normal Brake Selector Valve controls the supply of the normal system. The valve is supplied by the green hydraulic system and electrically controlled by the BSCU. It is set to OPEN when energized and CLOSED when de-energized.

PRESSURE SWITCH

The pressure switch measures the green hydraulic pressure upstream from the normal brake selector valve and supplies data to the BSCU.

SERVO VALVES

The servo valves, one per braked wheel, release brake pressures as a function of the pressure control orders and anti-skid orders generated by the BSCU.

HYDRAULIC FUSES

The hydraulic fuses (1 per braked wheel) are located downstream from the normal servo valves to prevent excessive fluid loss in case of brake line rupture. They require manual reset after activation.

NORMAL BRAKE PRESSURE TRANDUCERS

The normal brake pressure transducers, one per braked wheel, are located downstream from the hydraulic fuses to allow the BSCU to control and monitor the pressure delivered by the servo valves.

RETURN ACCUMULATORS

In addition, two return accumulators (1 per L/G) are installed on the return line of each normal brake manifold. They prevent pressure surge in the return line during brake release.

BRAKE UNIT SUPPLY

In the normal brake system, the green hydraulic power supply actuates one set of pistons on each brake unit.

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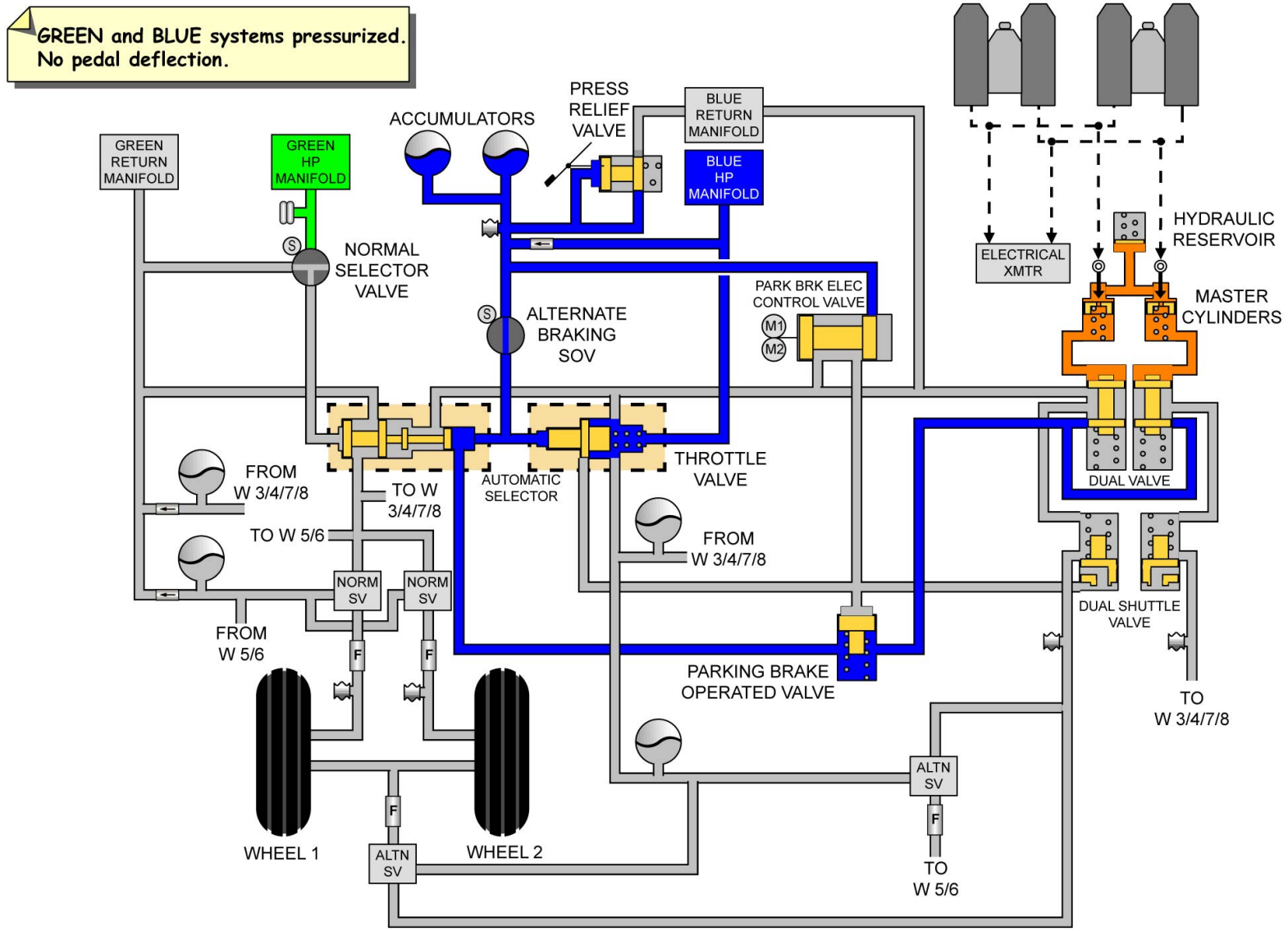

SYSTEM ARCHITECTURE ... DESCRIPTION

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NORMAL BRAKING D/O (3)

MANUAL BRAKING MODE

Brake pedal deflections are converted into a voltage signal by the brake pedal transmitter unit and transmitted to the BSCU. Following a positive pedal deflection of more than 2 degrees, the BSCU will energize the normal brake selector valve,
Which in turn port the fluid to the automatic selector valve. At this step, the green system prevails over the blue one.
The BSCU regulates the pressure through the servo valves. The current to the servo valve is proportional to the required pressure (ie.: 0A = 0press., 35mA = max. press.)
The BSCU will also provide ANTI-SKID signals to the servo valves. A pressure transducer downstream of the normal brake fuse confirms green pressure is available to the system. The normal brake pressure transducers transmit signals (corresponding to the applied pressure on the brakes) to the BSCU.

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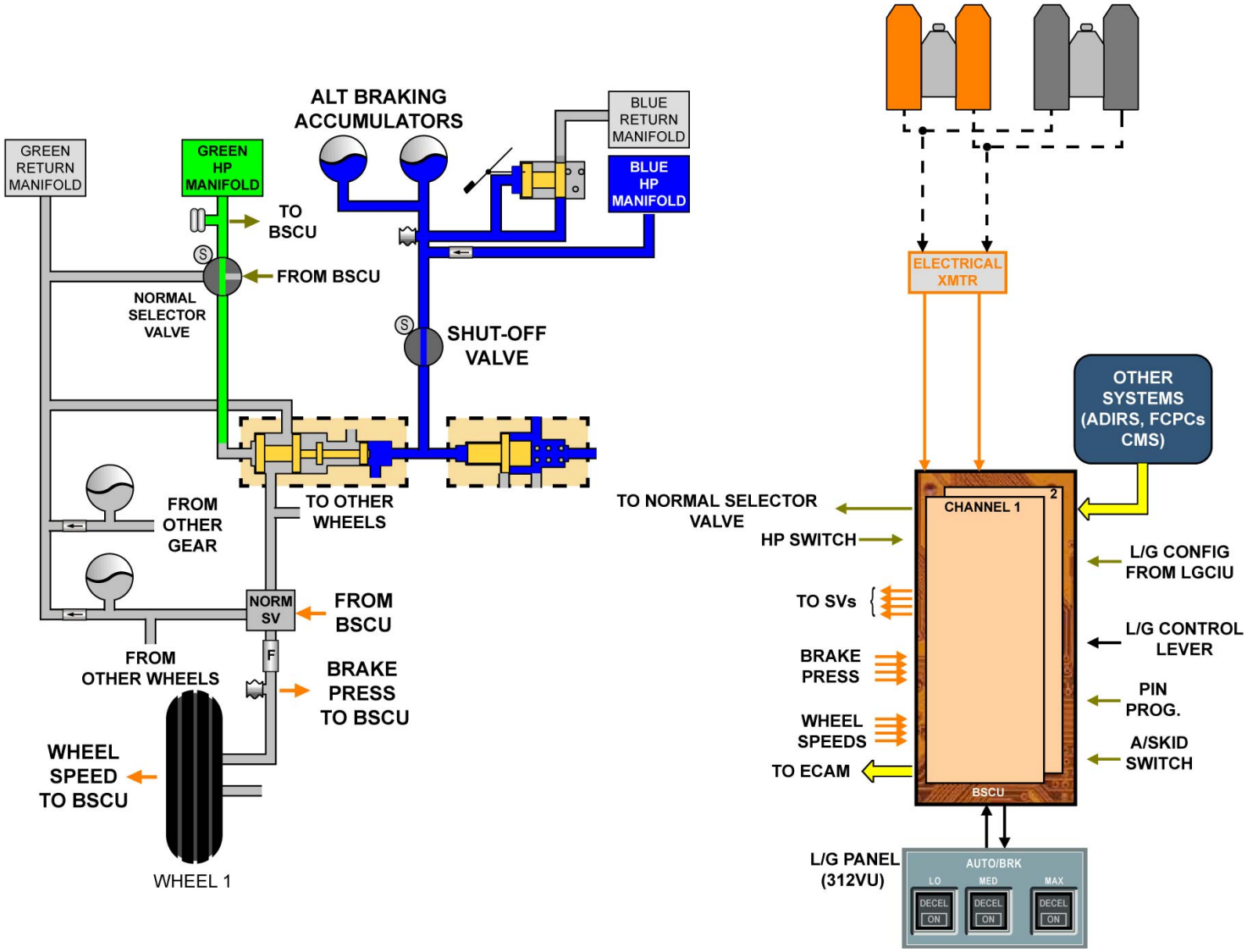

MANUAL BRAKING MODE

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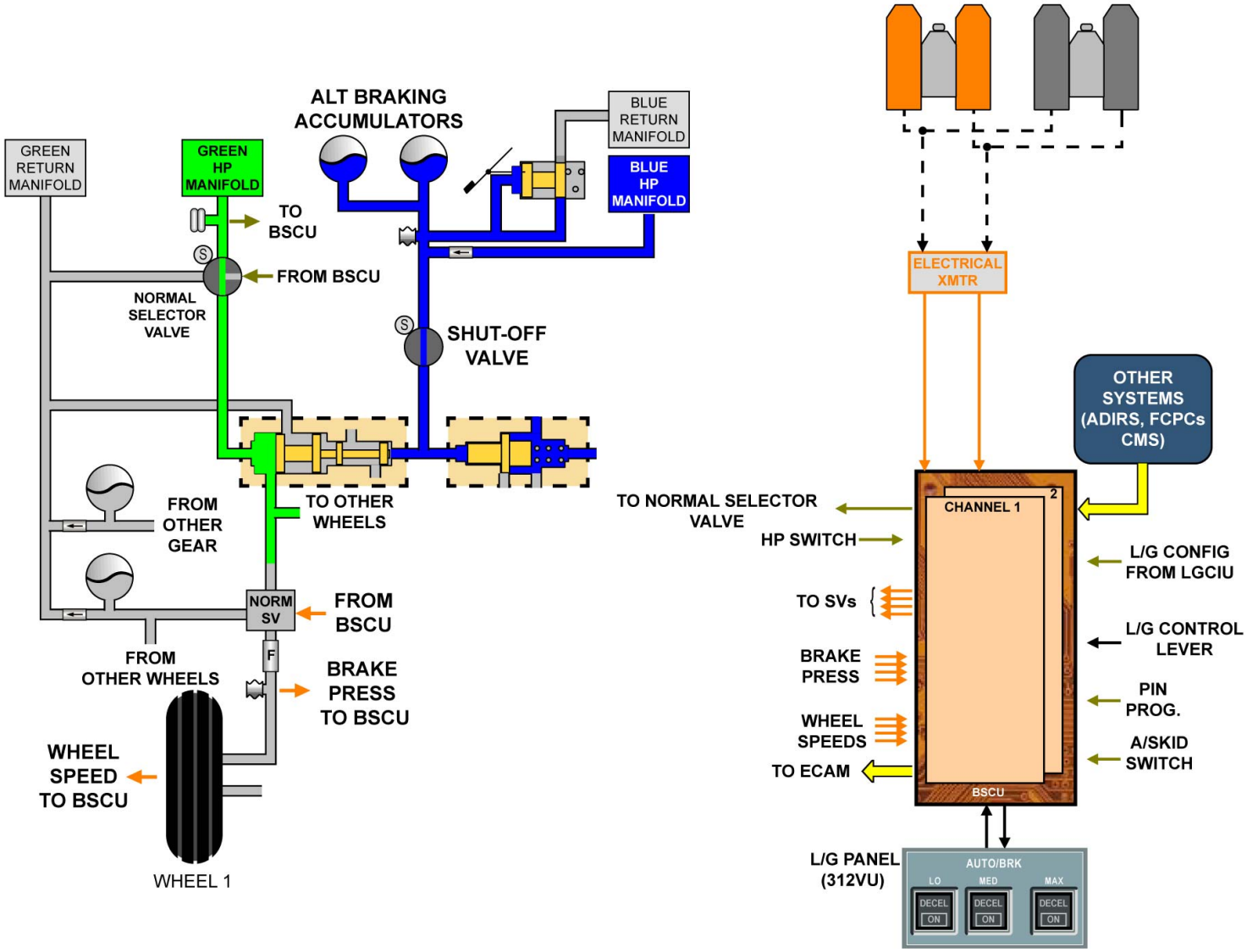

MANUAL BRAKING MODE

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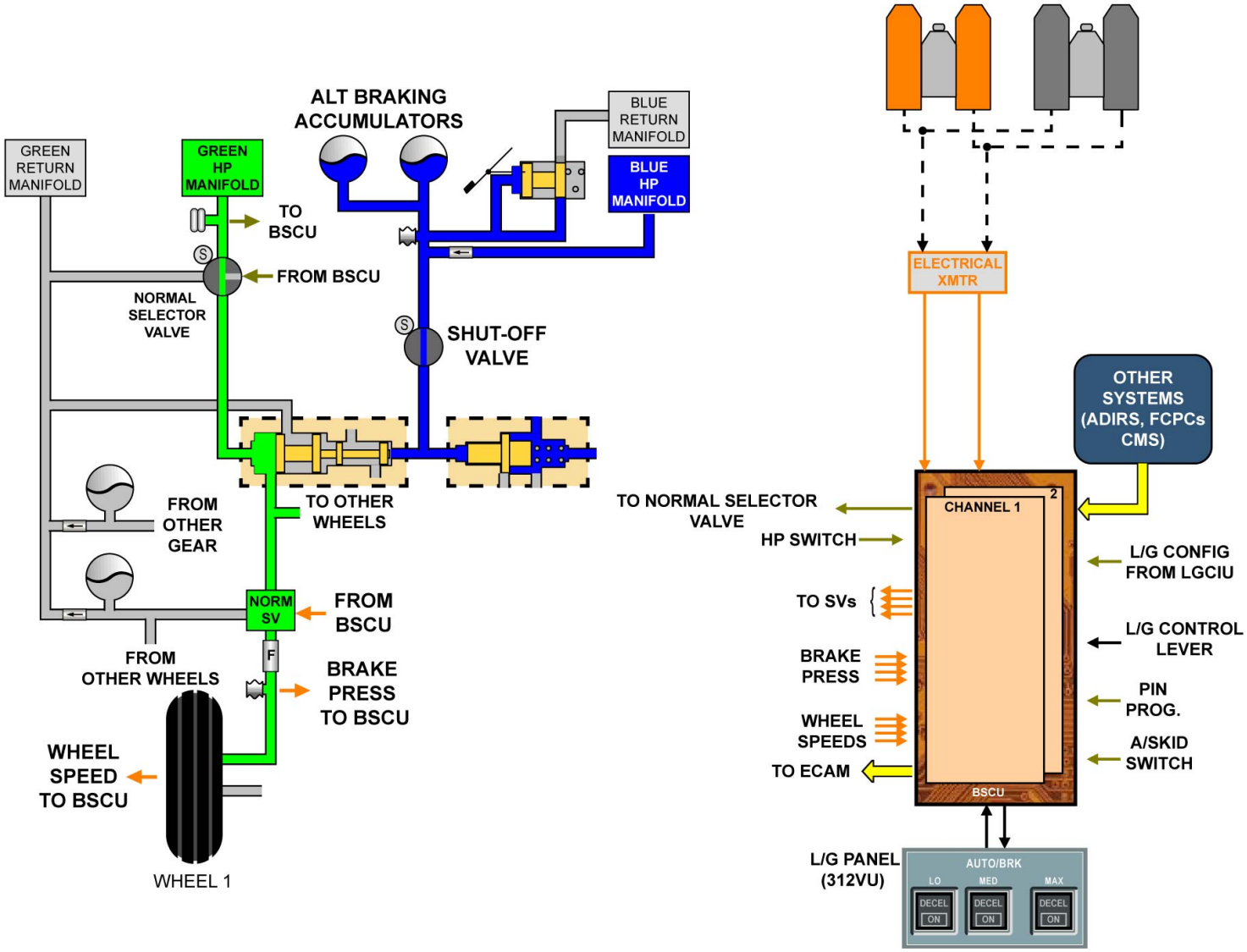

MANUAL BRAKING MODE

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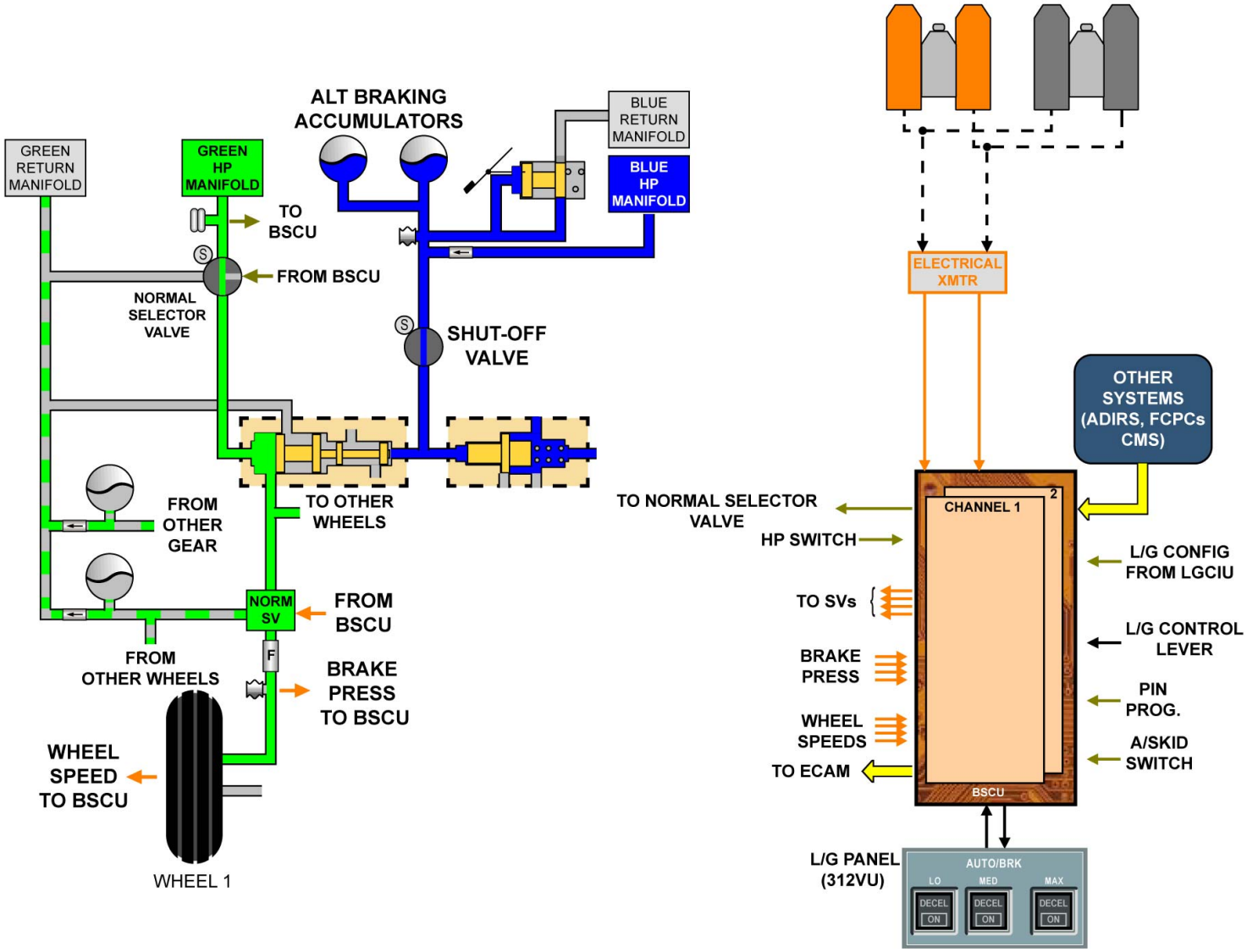

MANUAL BRAKING MODE

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NORMAL BRAKING D/O (3)

AUTO BRAKING MODE

When selected, the auto brake system automatically activates all the main wheel brakes via the normal braking system. The BSCU controls the servo valves to apply the level of braking required to decelerate the A/C. The pilot can select one of three preset rates, via the auto push buttons switch on the L/G instrument panel. During auto brake operation, the anti-skid function is available. The auto brake function is armed when the following conditions are met:
- green hydraulic pressure available,
- no BSCU failures, which prevent correct operation of auto brake,
- at least two Flight Control Primary Computers (FCPCs) available.
- at least one Air Data/Inertial Reference Unit (ADIRU) available.

Following the arming selection, the auto brake mode (Landing modes) is activated when both the left and right L/G wheels have compressed, and the BSCU receives two out of three ground spoiler deployed signals from the FCPCs. The BSCU opens the normal brake selector valve, and regulates the servo valves pressure anti-skid control. The commanded deceleration is achieved using an auto brake program, which computes an auto brake pressure order as a function of the required deceleration and the actual A/C deceleration received from the ADIRUs.
The auto brake engagement is lost if auto brake is manually disarmed by selection at the auto brake panel, or by pressing one brake pedal above 80% or both pedals above 60%. When auto brake is engaged the green DECEL illuminates at 80% of the required rate of deceleration. If a second auto brake mode is selected, either before or during the operation of the system, the second deceleration mode is selected.

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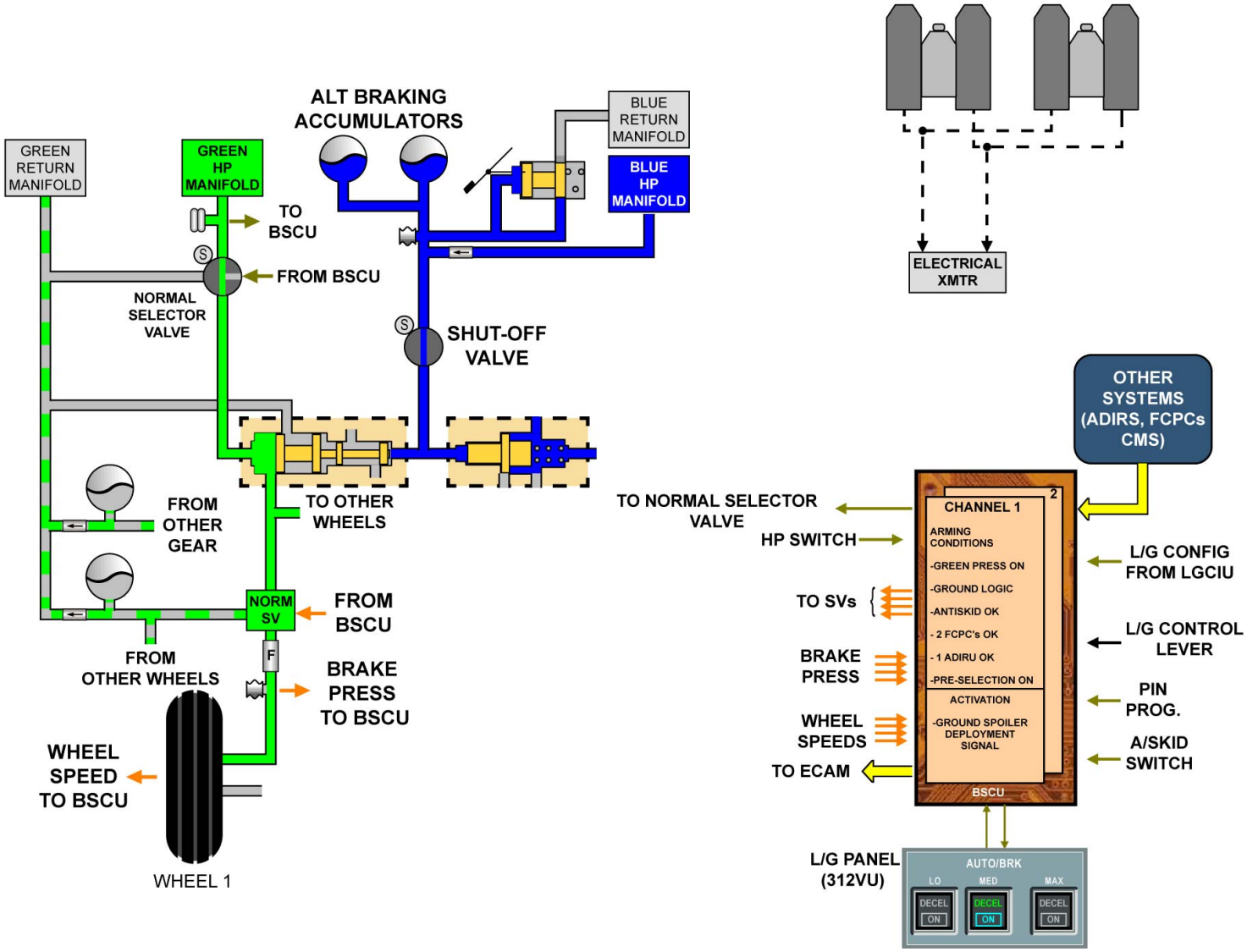

AUTO BRAKING MODE

NORMAL BRAKING D/O (3)

IN-FLIGHT BRAKING MODE

Braking occurs automatically during the retraction of the L/G. This stops the rotation of the MLG wheels before the L/G retracted goes into the related bays. When the L/G selector lever is put in the UP position, the normal brake selector valve is energized in order to connect the green hydraulic pressure to the brake manifolds. The servo valves are energized with a set control current to get the necessary pressure. After 3 sec. or when the NLG moves away from the downlocked position, the normal brake selector valve and servo valves are de-energized. This connects the system to return to release the pressure at the brakes.

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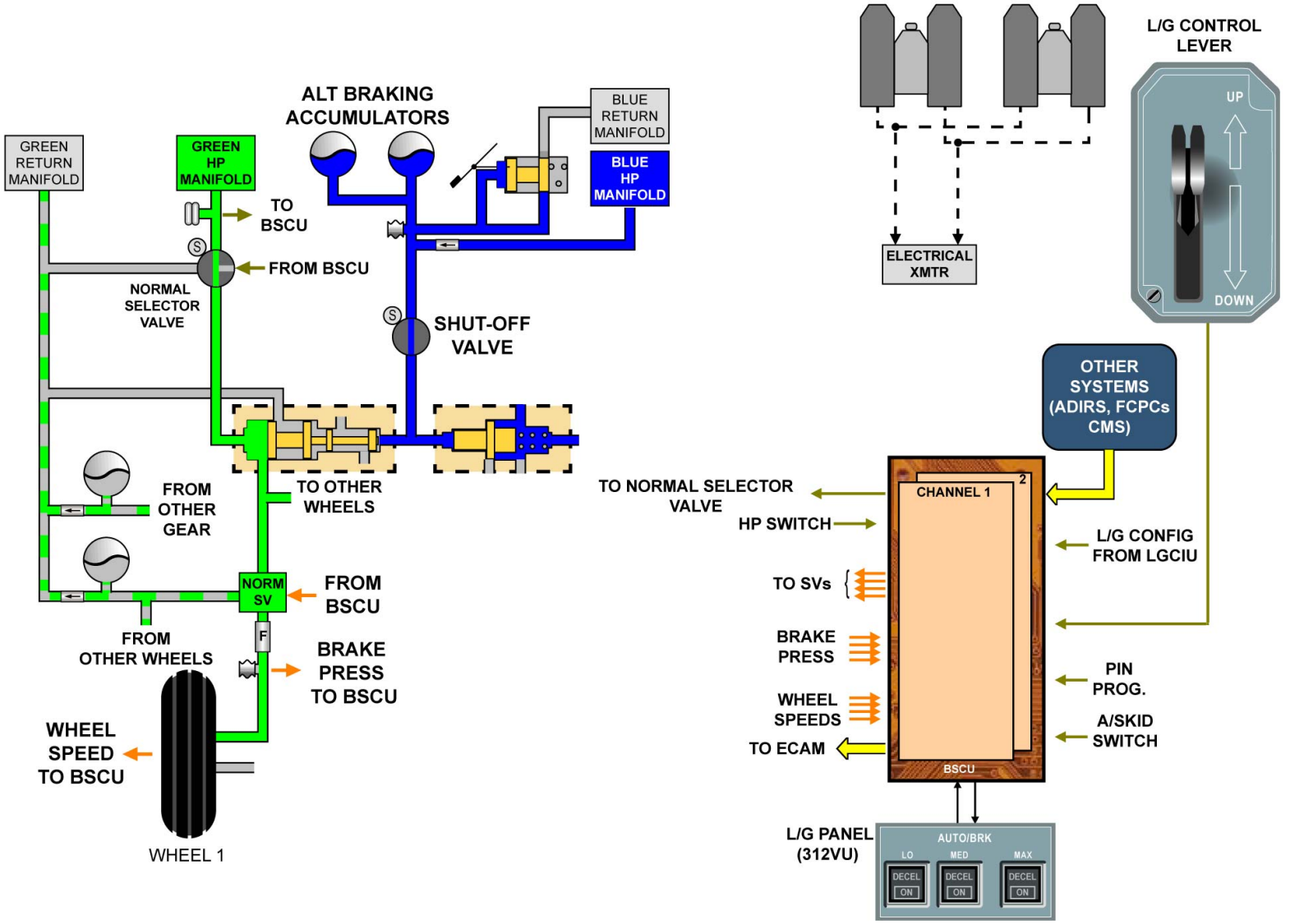

IN-FLIGHT BRAKING MODE

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NORMAL BRAKING D/O (3)

ANTI-SKID PROTECTION

The anti-skid system implements a protection algorithm which inhibits braking before wheel spin-up and prevents loss of braking efficiency due to wheel skid during manual and auto braking modes. Anti-skid authority is reduced progressively at A/C speeds below 5 m/s. Anti-skid protection is implemented to achieve maximum braking efficiency under all runway conditions and tire/brake conditions, and it is available in normal (including auto brake) and alternate modes. The system uses wheel speed (measured by tachometers installed in the axles of each of the MLG wheels) and A/C reference speed together with other parameters to compute brake release orders (anti-skid current orders).
These are summed with the braking orders (commanded currents) from pedals or auto brake in order to maintain wheel slip at the optimum level for maximum retardation over varying runway surfaces. In the normal system, anti-skid protection is given on an individual wheel basis. The anti-skid current orders are combined with the related corrected currents to produce the normal brake servo-valve current orders. The pin programming used to specify brake type lets the anti-skid protection tuned to brakes from different manufacturers.
The braking efficiency for normal braking under all runway conditions will be at least 92% when anti-skid is operative. Wheel locking will not occur on icy runways, in stable conditions, providing that A/C ground speed is greater than 20 m/s. Anti-skid operation will not cause loss of braking at any speed or during any A/C maneuver. When the anti-skid system is releasing the brake pressure, 3 vertical green lines are displayed beside the related wheel number on the ECAM wheel page.

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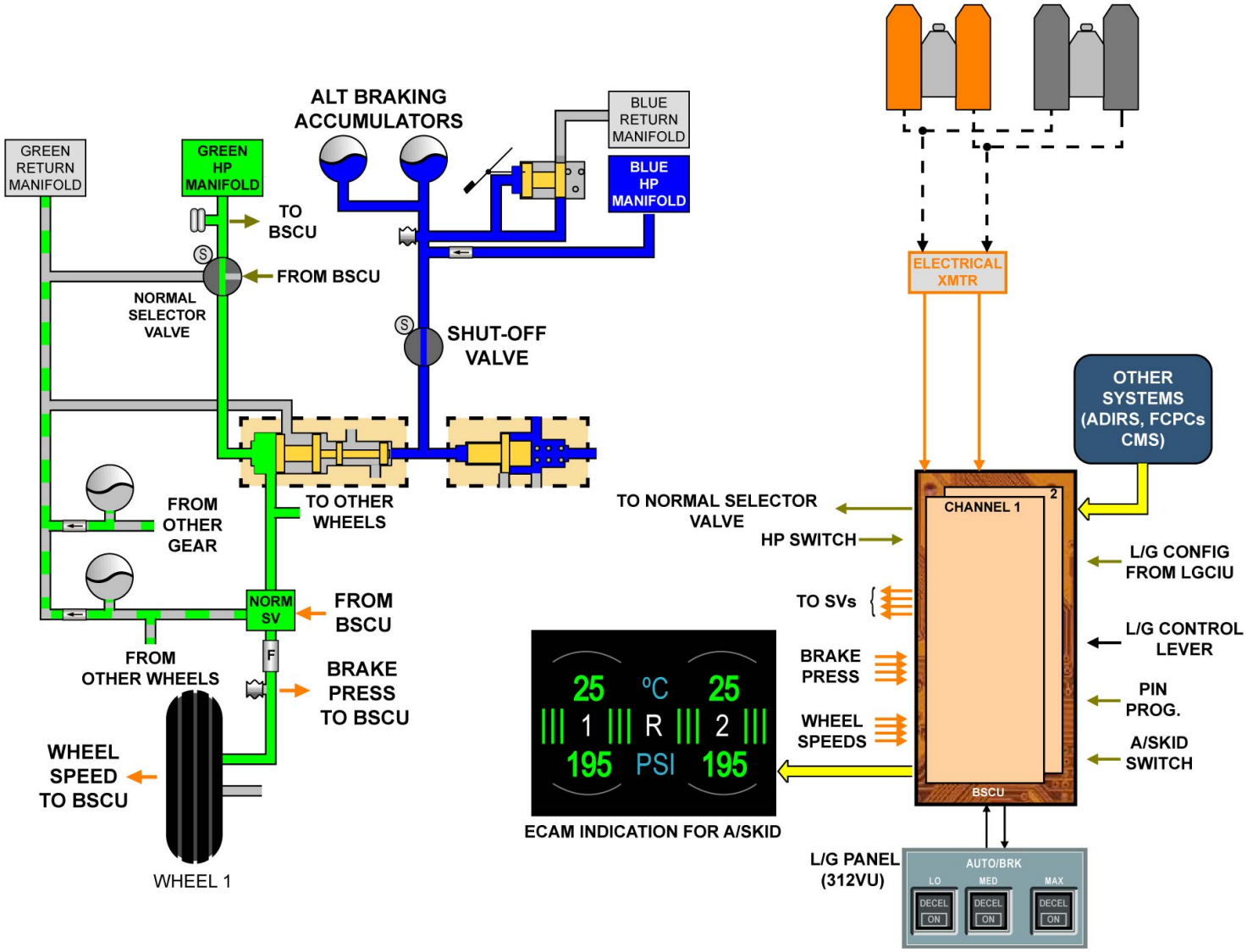

ANTI-SKID PROTECTION

ALTERNATE BRAKING D/O (3)

SYSTEM ARCHITECTURE

This graphic presents the entire braking system architecture.

GENERAL

System operation will switch from normal to alternate braking when normal braking is unavailable due to:
- green hydraulic system failure,
- normal braking component failure,
- braking/Steering Control Unit (BSCU) specific failure
- anti-skid switch is OFF

DESCRIPTION

The alternate braking system is composed of different components, which will be described.

BRAKE PEDAL ASSEMBLIES

The brake pedal assemblies give signals to the BSCU for alternate braking with anti-skid (A/SKID) function. A LP hydraulic system is connected to the brake pedals. It gives artificial feel in proportion to the pedal travel and supplies a control pressure to the dual valve.

BSCU

The BSCU controls and monitors the alternate braking system with the A/SKID protection. It converts data for display and warnings, performs various tests and supplies information to the Central Maintenance System (CMS).

PRESSURE TRANSDUCER

A pressure transducer measures the blue accumulator pressure for cockpit indication. It measures pressure in the left and right alternate brake supply lines. The third one, measures the blue accumulators pressure for alternate braking.

TRIPLE INDICATOR

The triple pressure indicator provides the pressure indication of the alternate brake system plus accumulators pressure. An indicator band from 0 to 1000 psi is provided on the left and right brake pressure indicators for alternate braking without anti-skid.

BRAKE ACCUMULATOR

The accumulators are of the oleo-pneumatic bladder type. Parking brake accumulators are located forward of the main landing gear bay in the belly fairing. They are serviced from the blue hydraulic ground service panel, each having its own gage and inflating valve. They are able to provide seven applications of the brakes with no system pressure available. Two pressure gages are provided on the blue ground service panel for the correct servicing of the accumulators.

DUAL VALVE

The dual valve is a hydro-mechanical valve that controls the quantity of the hydraulic system pressure that goes to the brakes. It operates in proportion to the pressure that comes from the brake pedals.

DUAL SHUTTLE VALVE

The dual shuttle valve is located downstream from the dual valve. It supplies the brakes with pressure from the alternate circuit.

ALTERNATE BRAKE SERVOVALVE MANIFOLD ASSEMBLY

The alternate brake servovalve manifold assembly is installed downstream of the dual shuttle valve. It permits installation of hydraulic components in a limited space. It contains two servovalves, a return accumulator, one pressure relief valve, two fuses (safety valves).

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SERVO VALVE

The servo valves are electrically controlled. They are permanently energized with a minimum of current to get the pressure to the brake quickly. Current increases to a maximum value to release the pressure in the brake with A/SKID function. The alternate servo valves are identical to the normal servo valves. The electrical control is different:
- only one coil is connected to the electrical connector,
- the coil is only energized to release the pressure in the brakes.

PRESSURE RELIEF VALVE

The pressure relief valve lets the pressure in the return line go to the supply line when necessary conditions occur.

SAFETY VALVE

Safety valves are located downstream of the servo valves. They are normally sprung loaded open valves with up and downstream chamber s controlling valve position. With a leak downstream, the downstream chamber will lose pressure and the valve forced closed on its seat.

SHUT-OFF VALVE

To ensure that alternate braking remains effective following green system failure during a long flight, the shut-off valve, installed in the alternate braking system, prevents depressurization of the parking brake accumulators. The valve is energized to close if the blue system pressure falls. This stops the internal leakage through the dual valve, thus maintaining accumulator pressure. This valve de-energizes to open at landing gear selection.

HYDRAULIC FUSES

The hydraulic fuses, one per braked wheel pair, are located downstream from the shuttle valves to prevent excessive fluid loss in case of brake line rupture or brake assembly leakage.

ALTERNATE BRAKE PRESSURE TRANSDUCERS

The alternate brake pressure transducers, one per braked wheel pair, are located upstream from the alternate brake servovalve manifold assembly to allow the BSCU to control or monitor the pressure in the alternate brake supply line.

RETURN ACCUMULATORS

The return accumulators are bladder type accumulators. They are identical to the normal brake accumulators with a nitrogen charging point. Their function is to make sure the brakes release smoothly. Each one is fitted with a pressure gage for correct quantity of charging. Those return accumulators, one per L/G, are installed on the return line on each alternate brake manifold. They prevent pressure surge in the return line during brake release and reduce brake release time.

BRAKE UNIT SUPPLY

The alternate system is powered by the blue hydraulic system to actuate the second independent set of pistons on each brake unit.

RESERVOIR

The alternate brake reservoir is located in the avionics compartment. The reservoir provides sufficient quantity of pressurized hydraulic fluid to keep the master cylinders full. A transparent indicator with a red and green line indicates the low and correct fluid level in the reservoir.
They provide a related feel force during brake pedal operation. They change the mechanical input into an hydraulic pressure to operate the dual valve. Pedal pressure moves the spring and supplies pressure to the dual valve. With no pressure on the pedals, the spring and hydraulic pressure return the sliding assembly to its original position.

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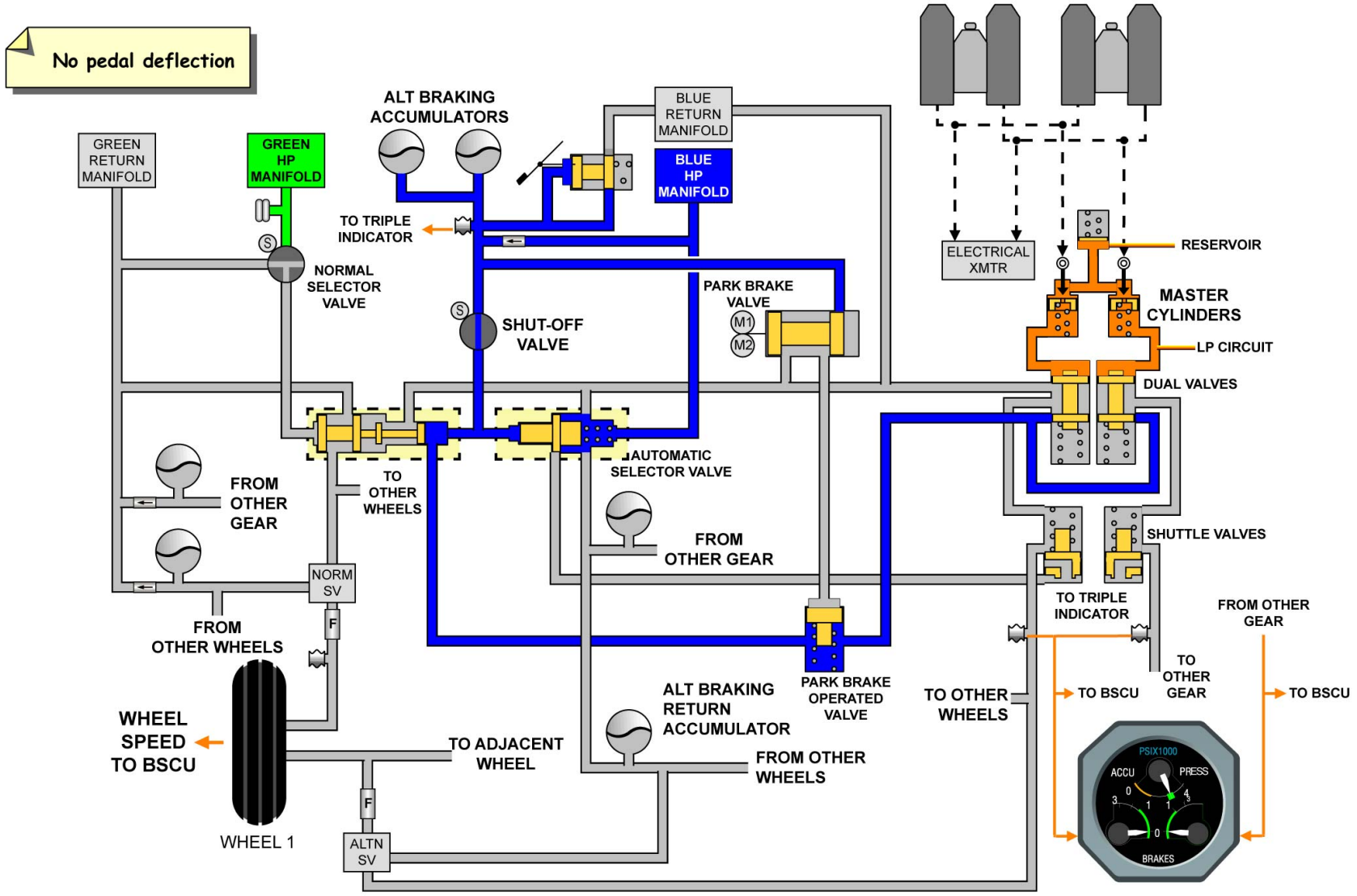

SYSTEM ARCHITECTURE ... DESCRIPTION

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ALTERNATE BRAKING D/O (3)

ALTERNATE BRAKE WITH ANTI-SKID

When the brake pedals are operated, pressure from the LP system is sent to the dual valve in proportion to the brake pedal travel. When the dual valves are displaced, the brake fluid pressure is then sent to the brake units via the shuttle valves and the alternate servovalves.

NOTE: There is no fluid mixture between the LP circuit and the blue alternate braking system fluids.

The pressure delivered to the left hand and right hand brakes as well as the blue accumulator pressure are indicated on the triple indicator.
If the wheel reaches a skid condition, the BSCU A/SKID protection will reduce the current to the appropriate servovalves, so the pressure to both wheels on the same axle is released which in turn port surplus fluid to return circuit.
The vertical lines are displayed at the corresponding pair of wheels on the ECAM wheel page

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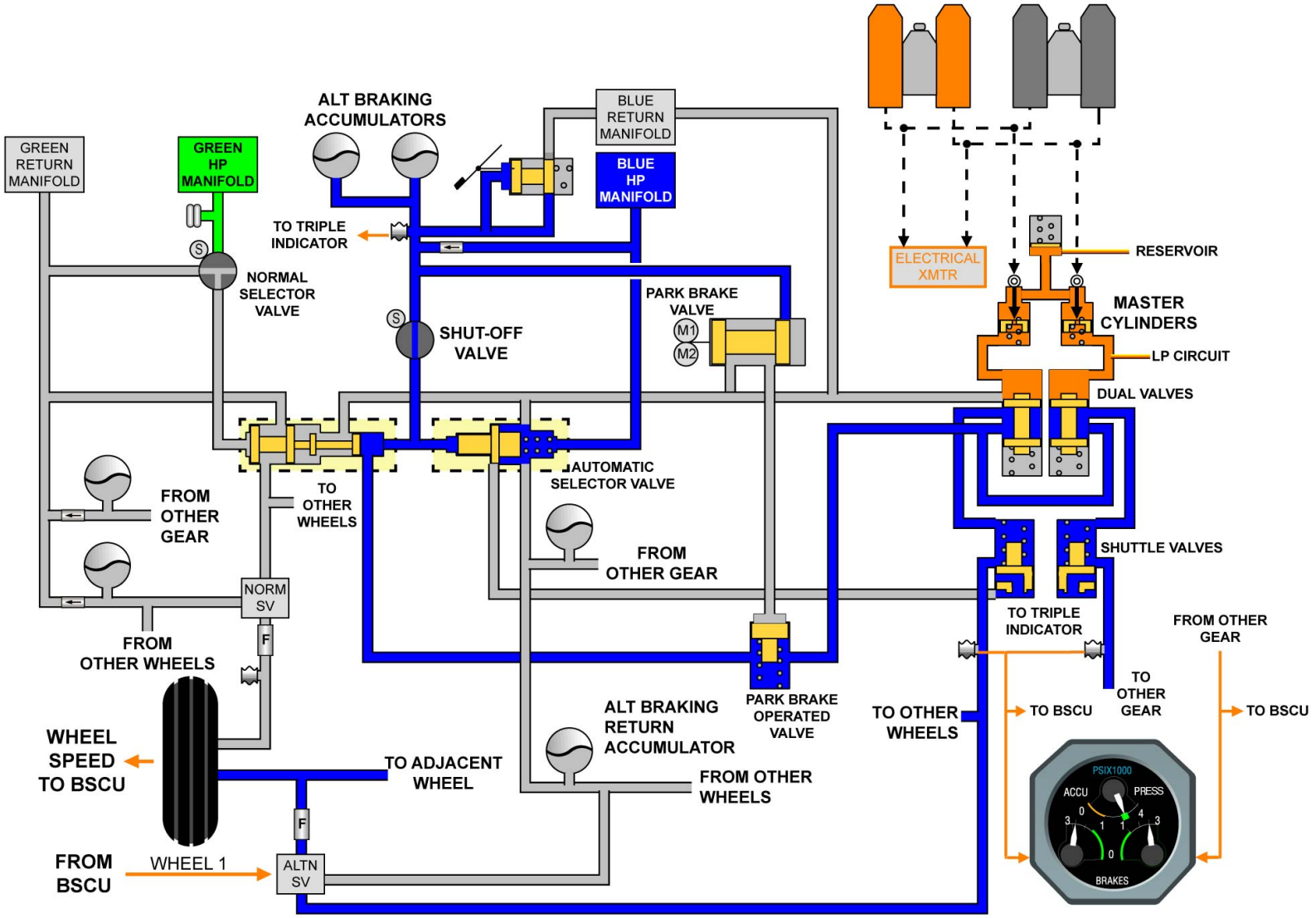

ALTERNATE BRAKE WITH ANTI-SKID

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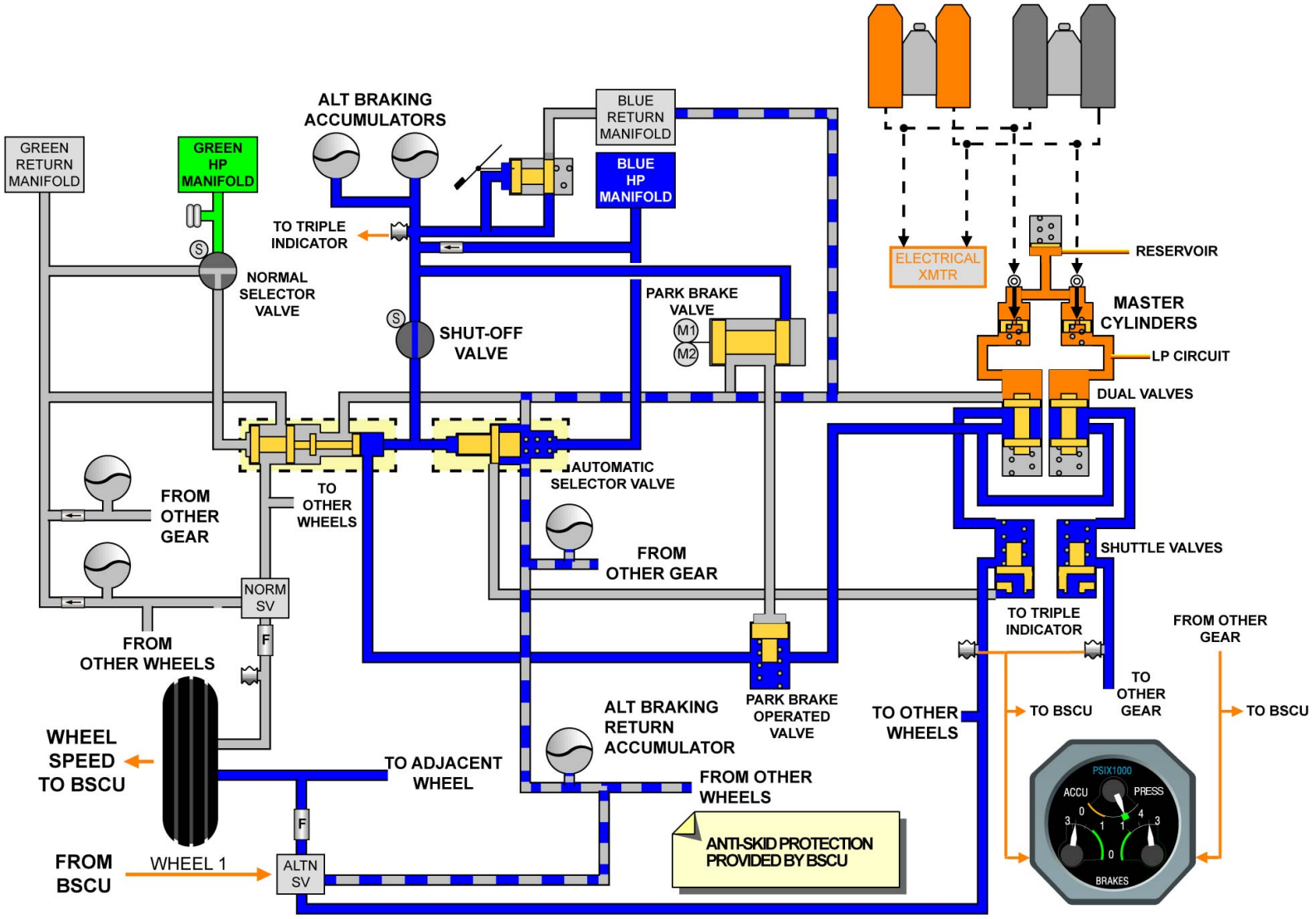

ALTERNATE BRAKE WITH ANTI-SKID

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ALTERNATE BRAKING D/O (3)

ALTERNATE BRAKE WITHOUT ANTI-SKID

The alternate brake without A/SKID is available when:
-the A/SKID switch is set to OFF,
-the BSCU is not available.
When the brake pedals are operated, pressure from the LP system is sent to the dual valve in proportion to the brake pedal travel. If the blue hydraulic supply is not available, accumulators give sufficient pressure for at least seven full applications of the brakes. The alternate servo valve remains fully open as it receives no anti-skid signals from the BSCU. The brake pressure has to be limited by the pilot to avoid wheel locking. The pressure delivered to the left hand and right hand brakes as well as the blue accumulator pressure are indicated on the blue pressure triple indicator.

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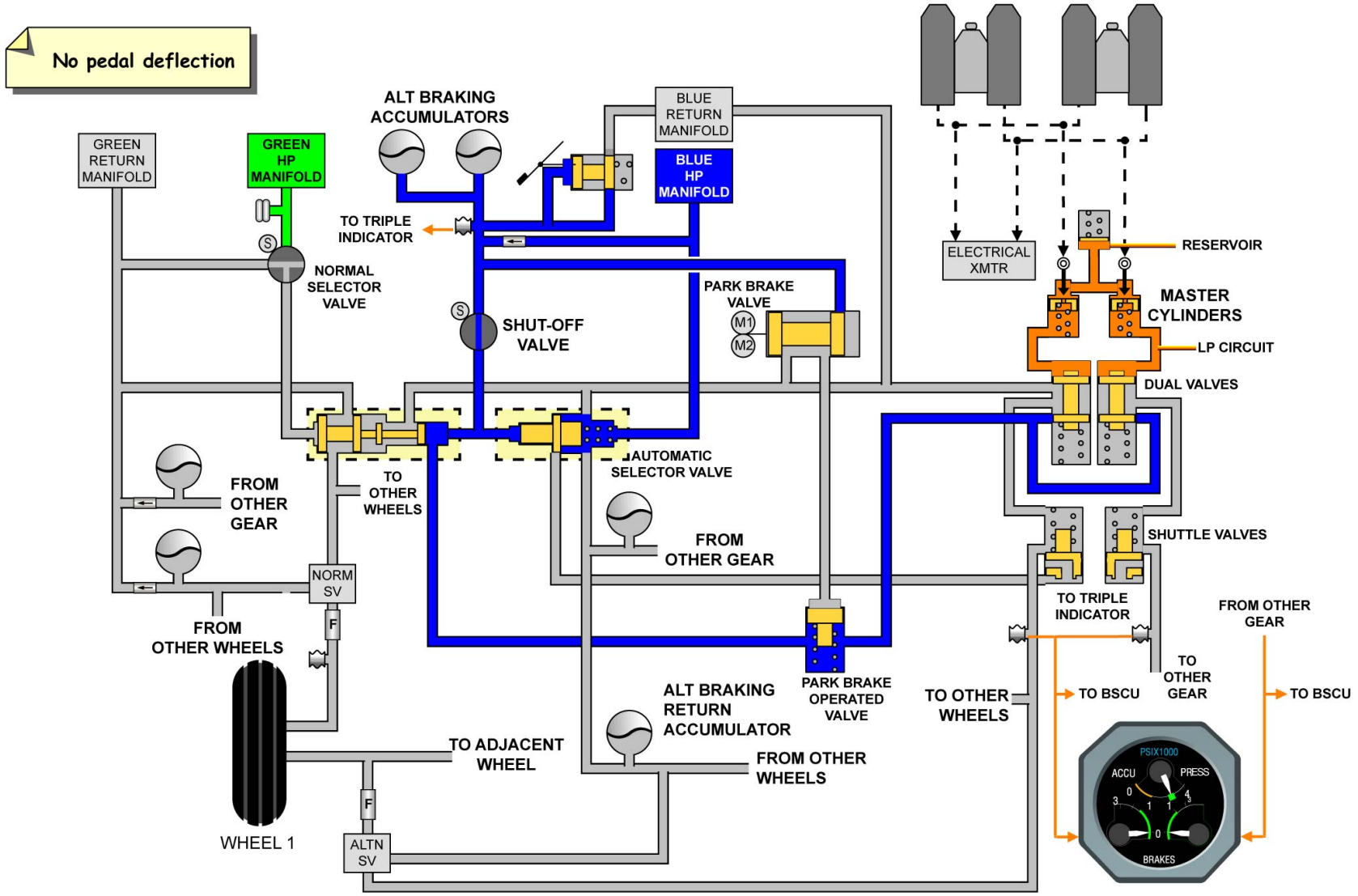

ALTERNATE BRAKE WITHOUT ANTI-SKID

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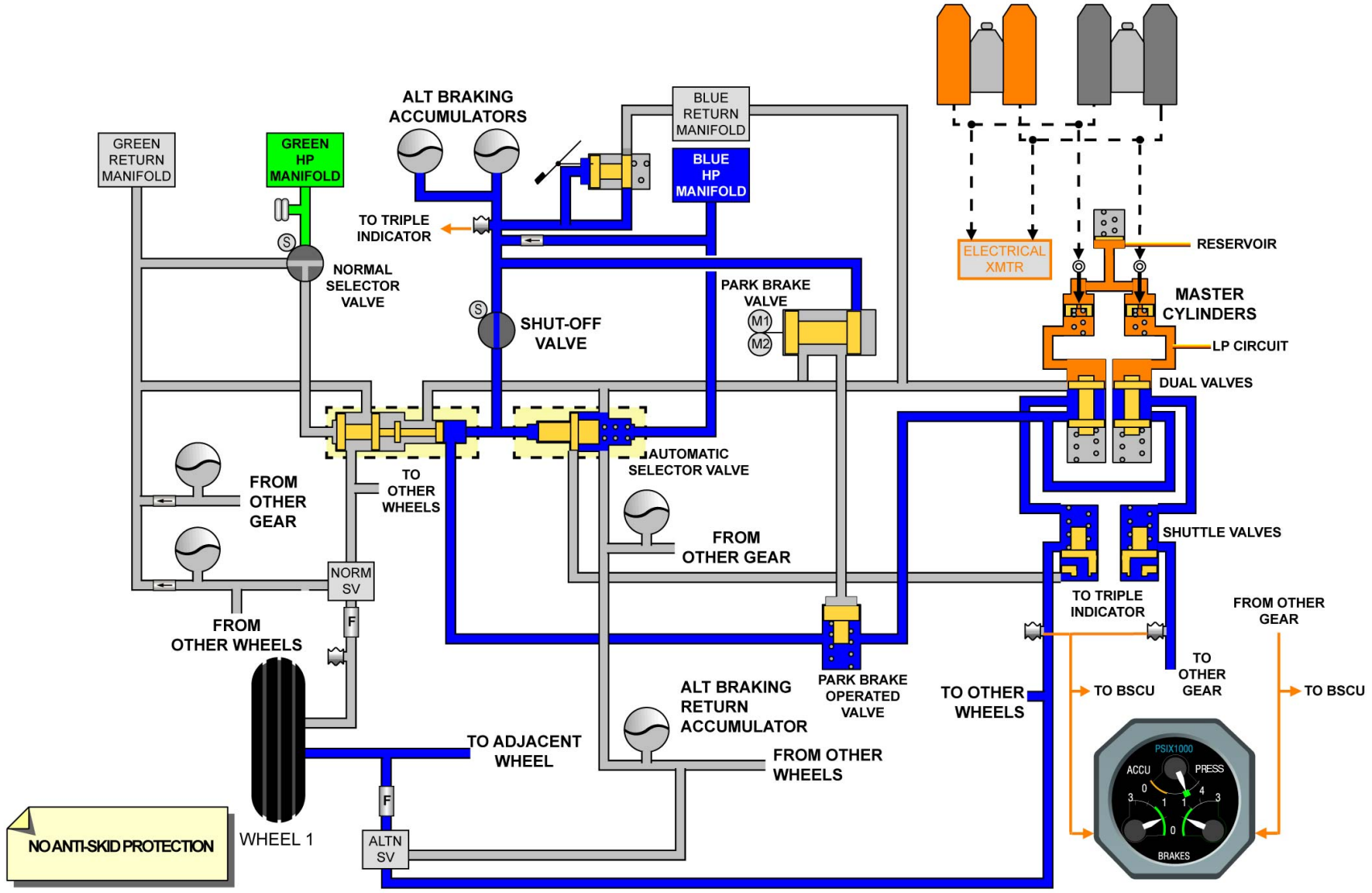

ALTERNATE BRAKE WITHOUT ANTI-SKID

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ALTERNATE BRAKING D/O (3)

ALTERNATE BRAKE PRESSURE INDICATION

The triple gage indicator provides left and right brake pressure indications by monitoring the applied pressure to the brakes mounted on the FWD axle on each MLG. The upper part of the gage displays the pressure available from the accumulators. The transducers, for applied pressure indication, are the same units, fitted to the alternate brake manifold, that supply pressure information to the BSCU.

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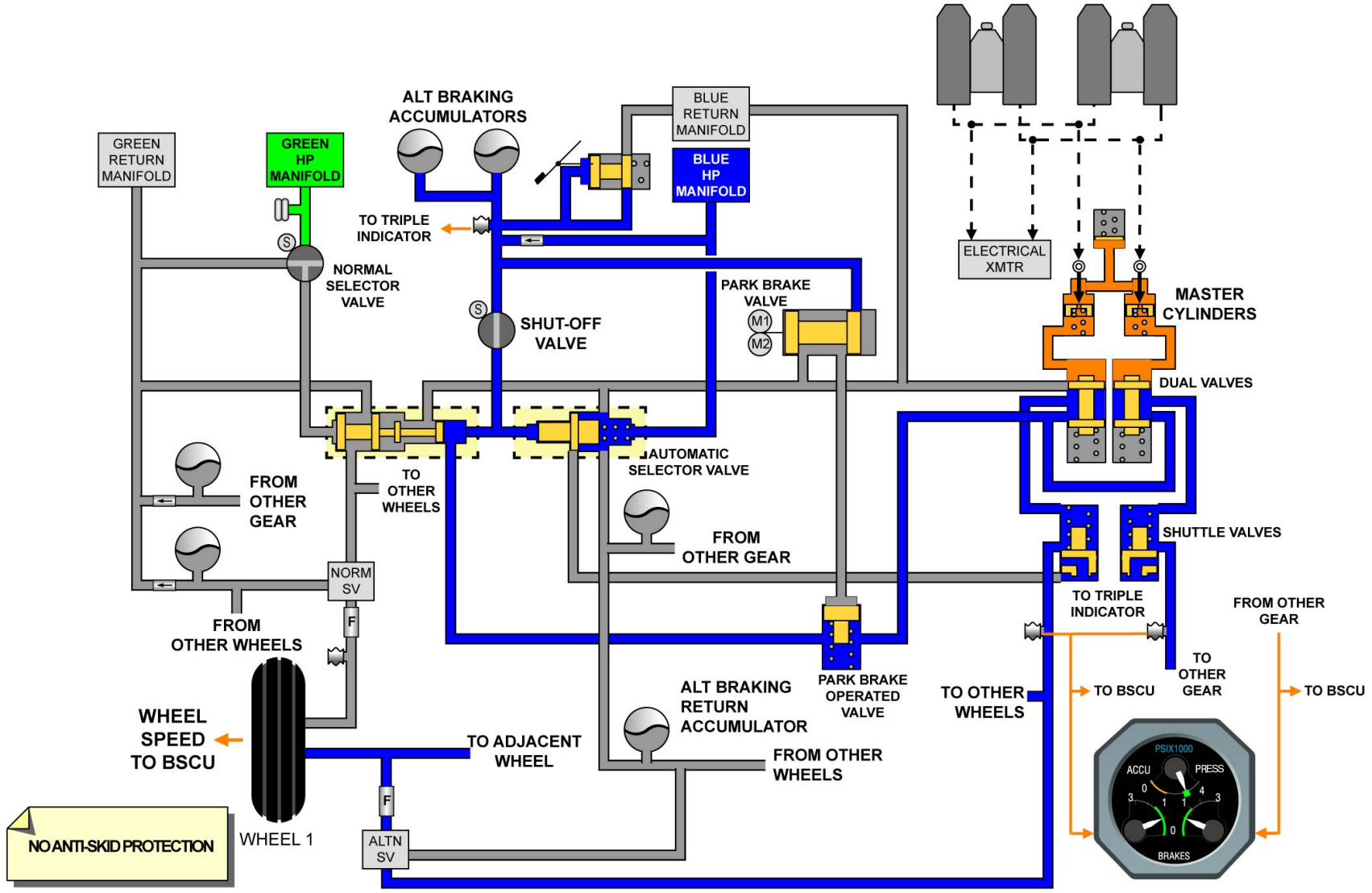

ALTERNATE BRAKE PRESSURE INDICATION

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PARK/ULTIMATE BRAKING D/O (3)

GENERAL

The park braking system is supplied by the blue system pressure or the brake accumulators. The park braking system is designed to prevent the A/C from rolling on a paved, level runway with take-off power on the critical engine, and all other engines at ground idle. When active, it will cause the Brake/Steering Control Unit (BSCU) to inhibit all other braking modes.
When the parking brake selector switch, in the cockpit, is set to ON, the motors in the parking brake control valves are energized. Pressure is supplied to the automatic selector valve which closes the return lines from the alternate brake servovalves. Pressure is supplied to the parking brake operated valve which isolates the dual valve from the parking brake system. The dual shuttle valve connects the pressurized fluid to the brakes. Accumulator replenishment is automatic by means of the blue electric pump. The pressure in the brakes is required to be maintained for a duration of 12 hours at 175 bars (2540 psi). When the parking brake selector switch is set to OFF, the motors are energized to release the applied pressure and to open the hydraulic line to the blue return manifold.

DESCRIPTION

The park braking system is composed of different components.

PRESSURE RELIEF VALVE AND CHECK VALVE

The pressure relief valve and check valve are integral part of the brake accumulator manifold. A check valve prevents discharge of the accumulator when the blue hydraulic system is unavailable. The pressure relief valve enables the accumulator to be discharged automatically following an overpressure at 3400 psi, or manually for servicing.

ACCUMULATOR PRESSURE TRANSDUCER

The accumulator pressure transducer measures the blue hydraulic pressure at the brake accumulator manifold and sends signals to the triple gage indicator and BSCU.

BRAKE ACCUMULATORS

The park brake accumulators are of the oleo-pneumatic bladder type, and maintain a specific volume of pressurized hydraulic fluid in case of blue system failure. They are serviced at the blue hydraulic ground service panel, which is equipped with two pressure gages. The system design will allow the park breaking to be supplied by the accumulators for up to 12 hours after a blue system failure or shut off.

PARK BRAKING SELECTOR SWITCH

The PRK BRK selector switch is a four-pole, two-position (OFF/ON) switch that sends the power supplies to the park brake control valve.

PARK BRAKE OPERATED VALVE

Parking brake operated valve is located in the main landing gear bay. It is a mechanical valve containing one spring loaded shuttle valve. When the parking brake is selected "ON", the supply pressure from the parking brake control valve moves the shuttle valve on to its seat to isolate the supply from the automatic selector valve.

PARK BRAKE CONTROL VALVE

The park brake control valve is operated by two motors, which are supplied by the 28 VDC HOT BUS and by the 28 VDC SERVICE BUS. The limit switches in the valve motor will cancel the power supply when the selected position is reached. In the OFF position it connects the park braking supply from the manifolds to the blue system return. This is done by the parking brake operated valve and the automatic selector. When activated, the park brake control valve delivers a predetermined pressure (2500 psi) to the MLG brakes via

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the 4 alternate servo valves. It also sends an electrical signal to the BSCU in order to inhibit other braking modes. This signal is disabled within the BSCU if blue system pressure, sent to the brake units and monitored by the pressure transducers, falls below 1450 psi.

PARK BRAKE MANIFOLD

Parking brake manifold is located in the main landing gear bay. The manifold receives the blue hydraulic system supply and the two brake accumulators pressure. These are separated by the check valve. The manifold contains the pressure transducer and the pressure relief valve. The pressure relief valve operates to return at 265 bars(3843 psi). A manual lever can be operated to open the pressure relief valve.

DUAL SHUTTLE VALVE

Dual shuttle valve is located in landing gear bay. It contains two spring loaded shuttle valves. When the parking brake is selected "ON", the dual shuttle valve closes the supply to the dual valve and opens the supply to the alternate servo valves.

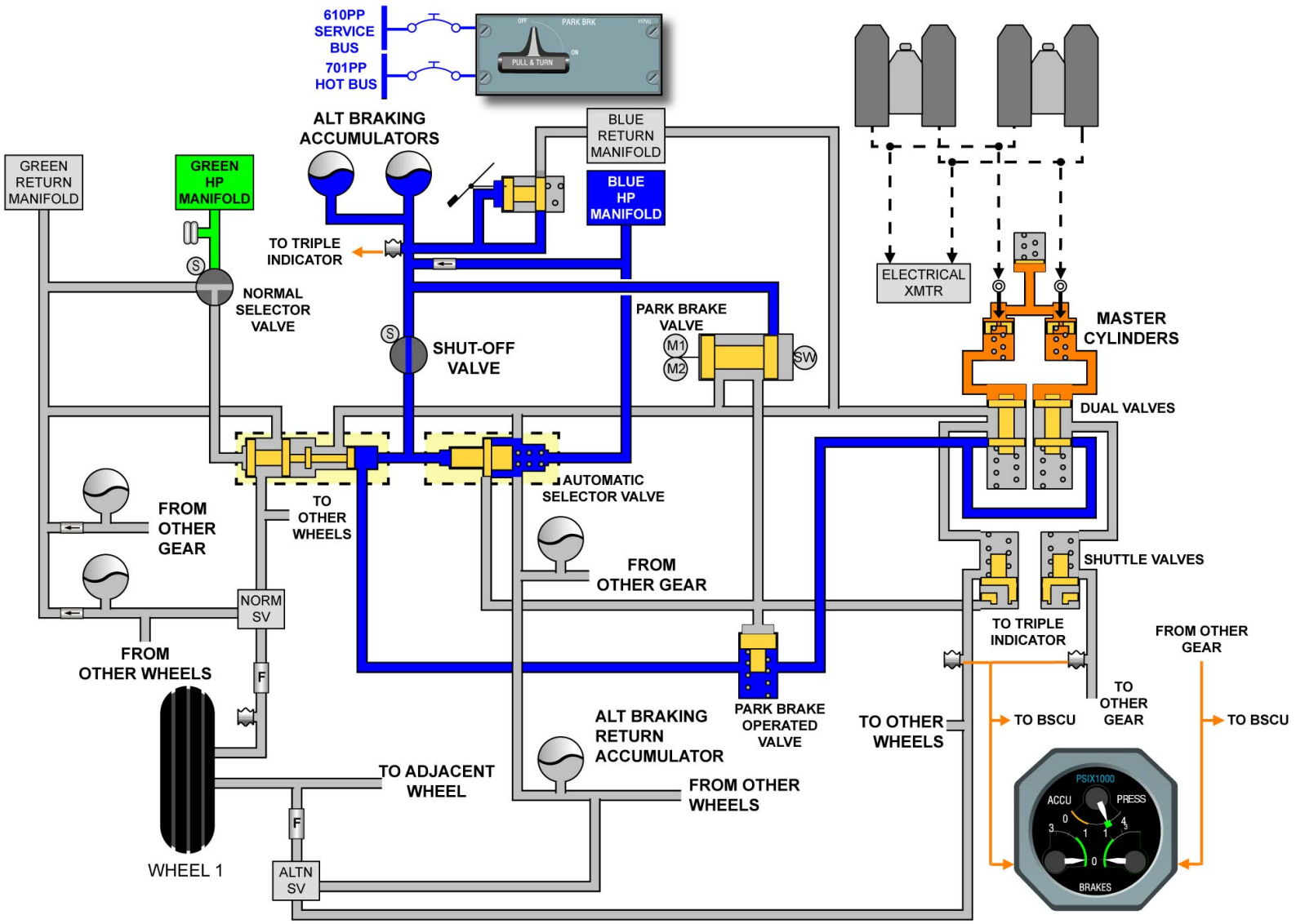
HYDRAULIC FUSES (F)

The hydraulic fuses (1 per braked wheel pair) are located downstream of the servo valves. They prevent excessive fluid loss in case of brake line cut or brake assembly leakage.

ALTERNATE BRAKE PRESSURE TRANSDUCERS (ALTN BRK PRESS XDCR)

The alternate brake pressure transducers on each MLG confirm parking pressure to the triple indicator.

G9409341 - GAUT0T0 - FM32D7000000003



GENERAL & DESCRIPTION

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G9409341 - GAUT0T0 - FM32D7000000003

PARK/ULTIMATE BRAKING D/O (3)

OPERATION

When the PRK BRK selector switch is set to ON, the motors in the park brake control valve are supplied and the valve opens. When the valve is open, it connects the hydraulic pressure supply to the park braking system, isolate the alternate servo valves return circuit and an electrical signal is sent to the BSCU in order to isolate the other braking modes. The park brake control valve is also a pressure-reducing valve that reduces the supply pressure to 175 bars (2500 psi) and sends the hydraulic pressure to the alternate brake manifolds of each MLG. The hydraulic pressure operates the shuttle valves to pressurize the alternate brake pistons. The triple gage pressure indicator shows the pressure that is available from the brake accumulators.

If the monitored park braking pressure (done by the pressure transducers) to the brake units falls below 1450 psi, the BSCU inhibition is no longer active. Therefore the normal braking system can be used provided the green hydraulic system is pressurized and pedals are depressed.

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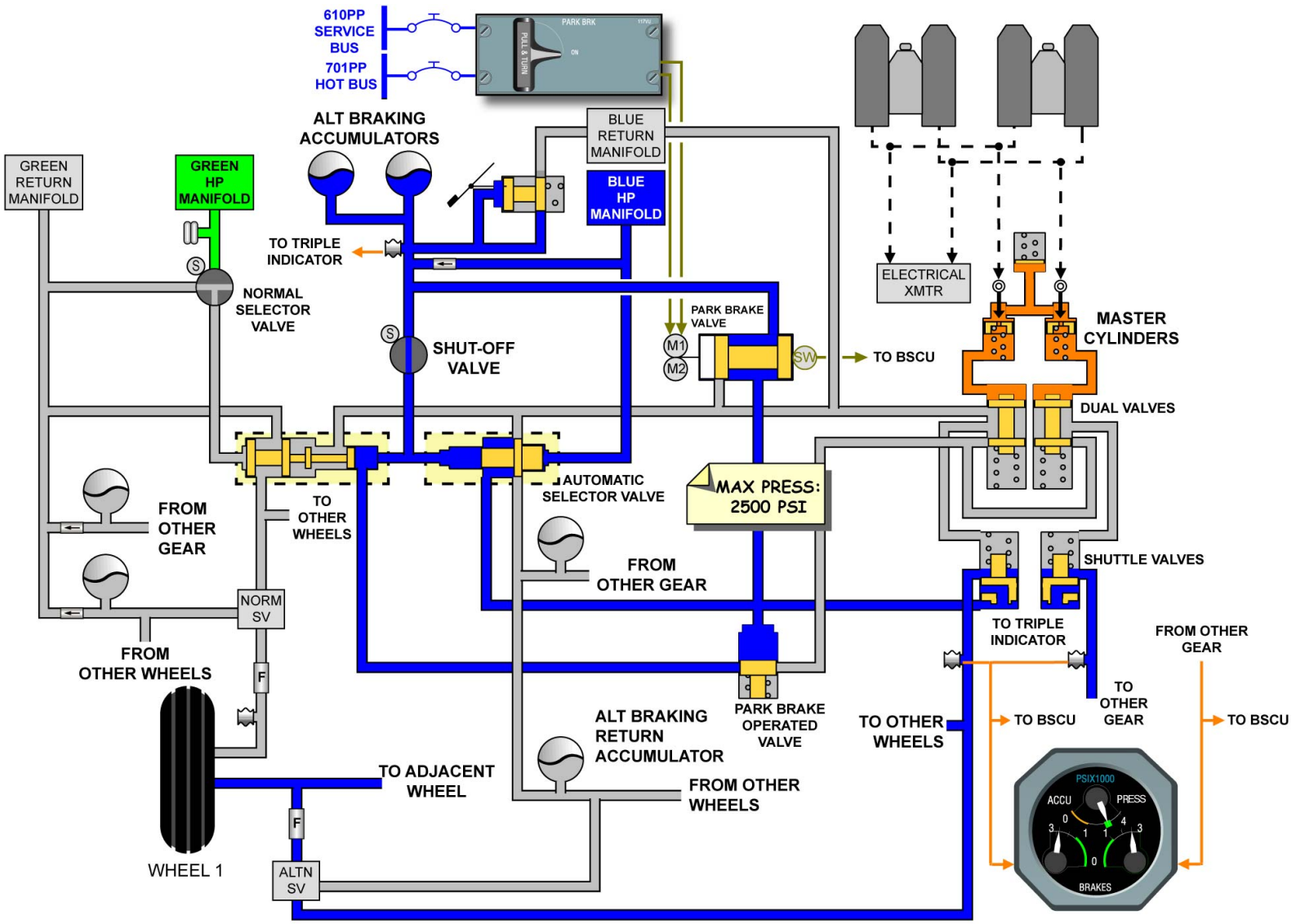
610PP SERVICE BUS
701PP HOT BUS
PARK BRK
PULL & TURN
ON
ALT BRAKING ACCUMULATORS
BLUE RETURN MANIFOLD
BLUE HP MANIFOLD
GREEN RETURN MANIFOLD
GREEN HP MANIFOLD
TO TRIPLE INDICATOR
NORMAL SELECTOR VALVE
SHUT-OFF VALVE
PARK BRAKE VALVE
M1
M2
SW
TO BSCU
ELECTRICAL XMTR
MASTER CYLINDERS
DUAL VALVES
AUTOMATIC SELECTOR VALVE
MAX PRESS: 2500 PSI
FROM OTHER GEAR
TO OTHER WHEELS
FROM OTHER GEAR
SHUTTLE VALVES
NORM SV
FROM OTHER WHEELS
TO TRIPLE INDICATOR
FROM OTHER GEAR
TO OTHER GEAR
TO BSCU
TO BSCU
ALT BRAKING RETURN ACCUMULATOR
PARK BRAKE OPERATED VALVE
TO OTHER WHEELS
TO ADJACENT WHEEL
FROM OTHER WHEELS
PSIX1000
ACCU
PRESS
BRAKES
WHEEL 1
ALTN SV

OPERATION

BRAKE TEMPERATURE AND COOLING SYSTEM D/O (3)

BRAKE SYSTEM TEMPERATURE

The brake temperature monitoring system is installed on each wheel of the Main Landing Gear. An accessible chromel alumel thermocouple sensor is installed in each brake to monitor the brake heat pack temperature.
The 8 chromel alumel temperature sensors independently deliver a voltage, proportional to the temperature difference between the cold junction and the hot junction, to the Brake Temperature Monitoring Units (BTMUs). Each BTMU, for each pair of brakes, compensates and amplifies the temperature sensor voltage signal of the related brakes. Each BTMU outputs a voltage to the Braking and Steering Control Unit (BSCU). The BSCU changes the BTMU inputs from analog data to digital data.
The BSCU transmits data to the ECAM, monitors the system components and transmits the data to the Central Maintenance Computer (CMC).

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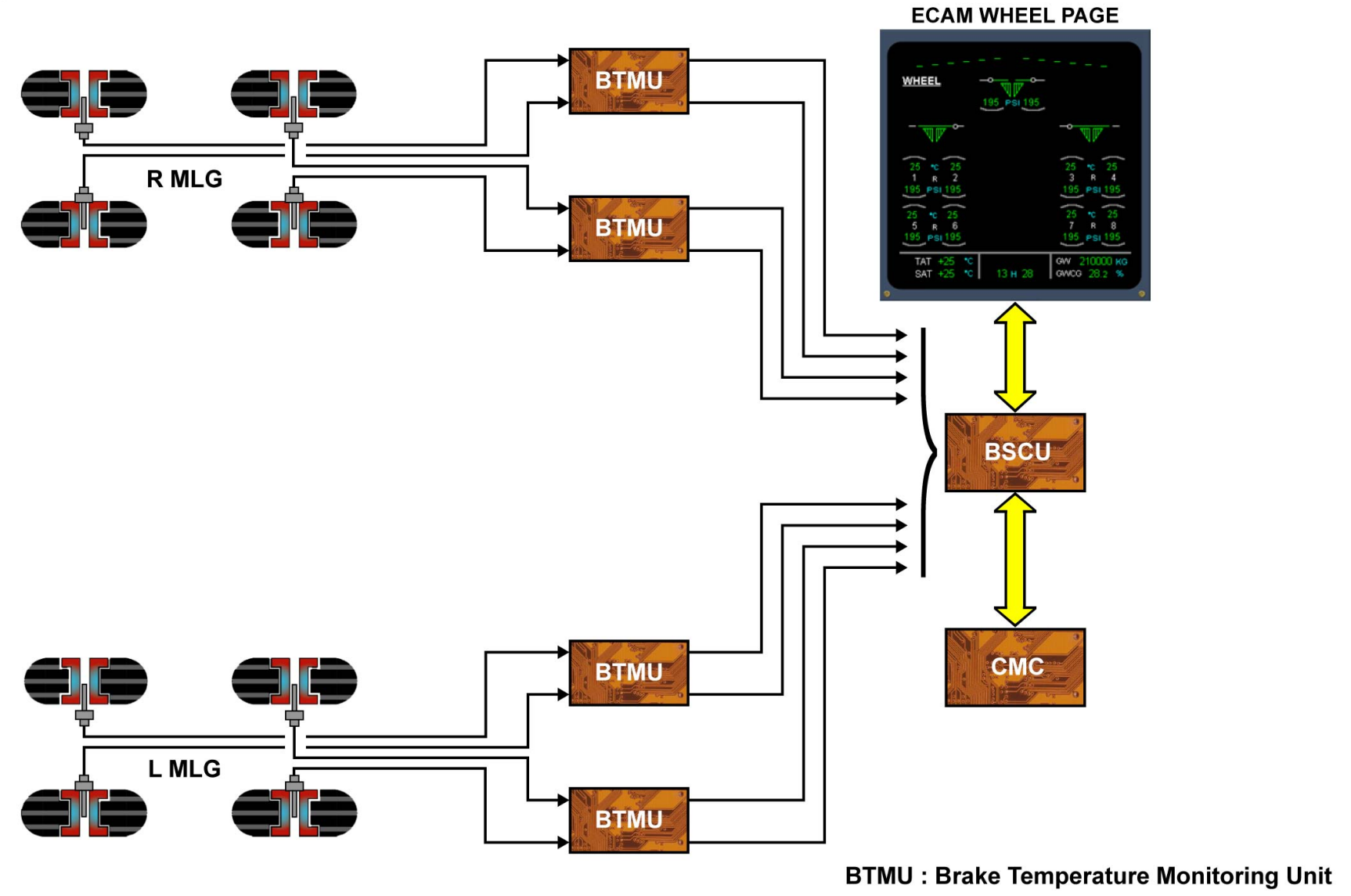

BRAKE SYSTEM TEMPERATURE

BRAKE TEMPERATURE AND COOLING SYSTEM D/O (3)

BRAKE COOLING

The brake cooling system is a manually controlled system that decreases the brake temperature. The system is usually used on ground as soon as the landing gear is extended and locked down.
When a brake is hotter than the overheat temperature threshold, the HOT sign of the pushbutton comes on amber.
When the pushbutton, on the landing gear panel, is manually operated, the ON light comes on and controls the operation of the system. It connects the brake fan relays, which operate to supply 115 VAC to the brake fan.

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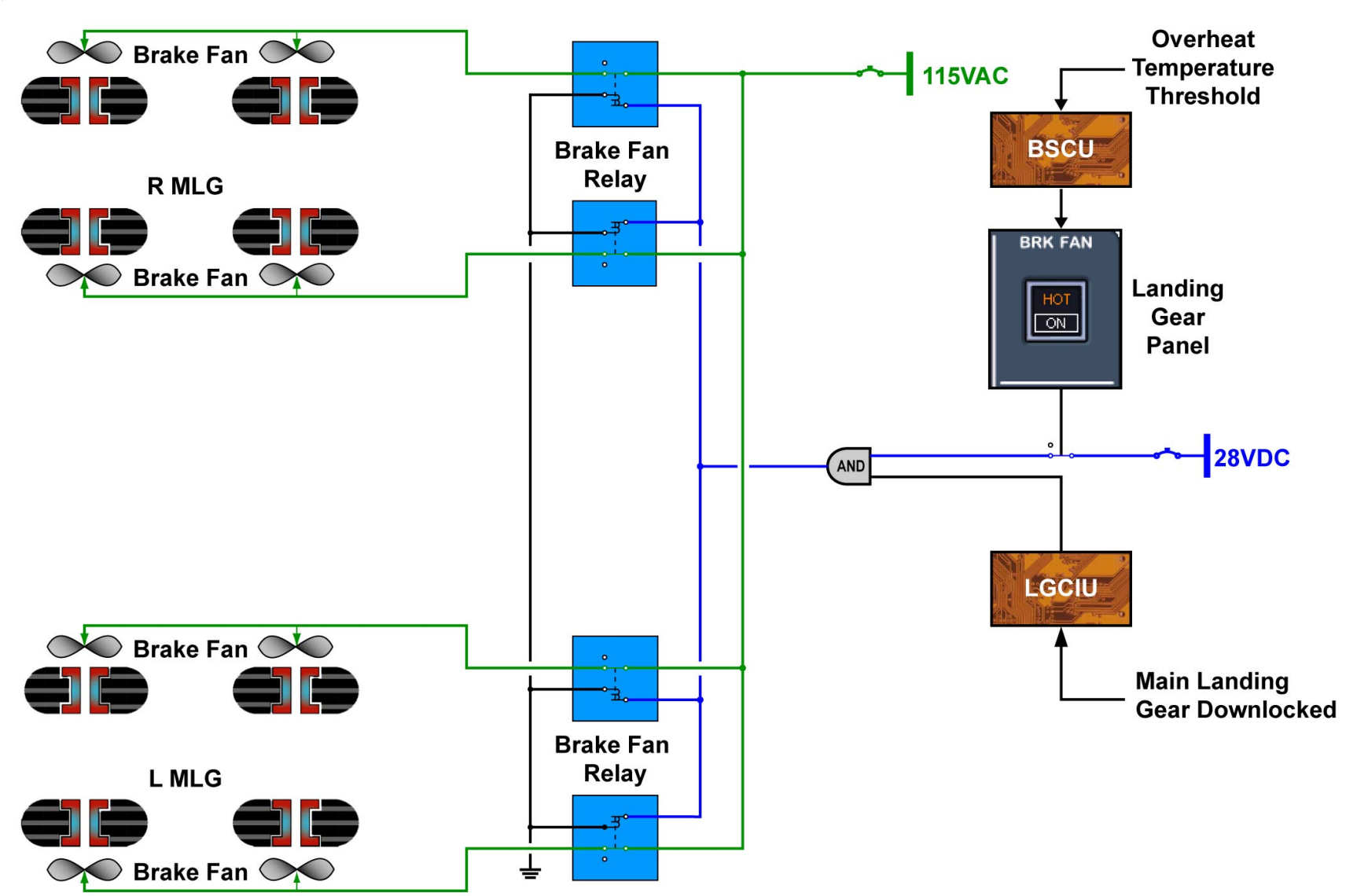

BRAKE COOLING

G9409341 - GAUT0T0 - FM32DA000000001

TPIC D/O (3)

PURPOSE

The Tire Pressure Indicating System (TPIS) continuously monitors the absolute pressure of each individual tire and provides cockpit indications and warnings.

PRESSURE SENSOR

A pressure sensor installed in the wheel rim measures the pressure of each tire. The pressure sensor gives a DC signal from 0 to 100mV in proportion to the pressure.

ROTATING MECHANISM

The rotating mechanism serves to transmit the tire pressure signal from the wheel to the axle. The rotating transmitter also provides the necessary power supply for the electronic module and the pressure sensor in the form of a 3125Hz signal.

ELECTRONIC MODULE

The integrated electronic module amplifies the signal from the pressure sensor and changes the voltage into frequency by means of a converter. The voltage to frequency converter gives a signal which varies from 50 to 100kHz for a pressure range from 0 to 300 psi.

ROTATING TRANSMITTER

The rotating transmitter transmits the tire pressure value from the wheel to the TPIC.

TPIC

The detection unit in TPIC comprises a microprocessor which provides data processing and distribution of each tire pressure including normal and abnormal pressure signals for ECAM indication and Centralized Maintenance System (CMS) monitoring. The TPIC permanently performs a test of the unit itself, the rotating mechanism and the pressure sensor. The test is only stopped for data processing and distribution.

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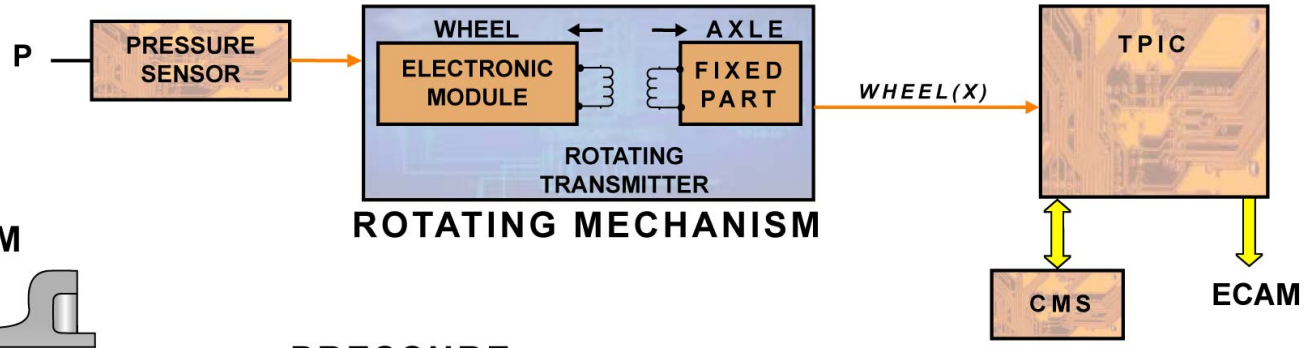
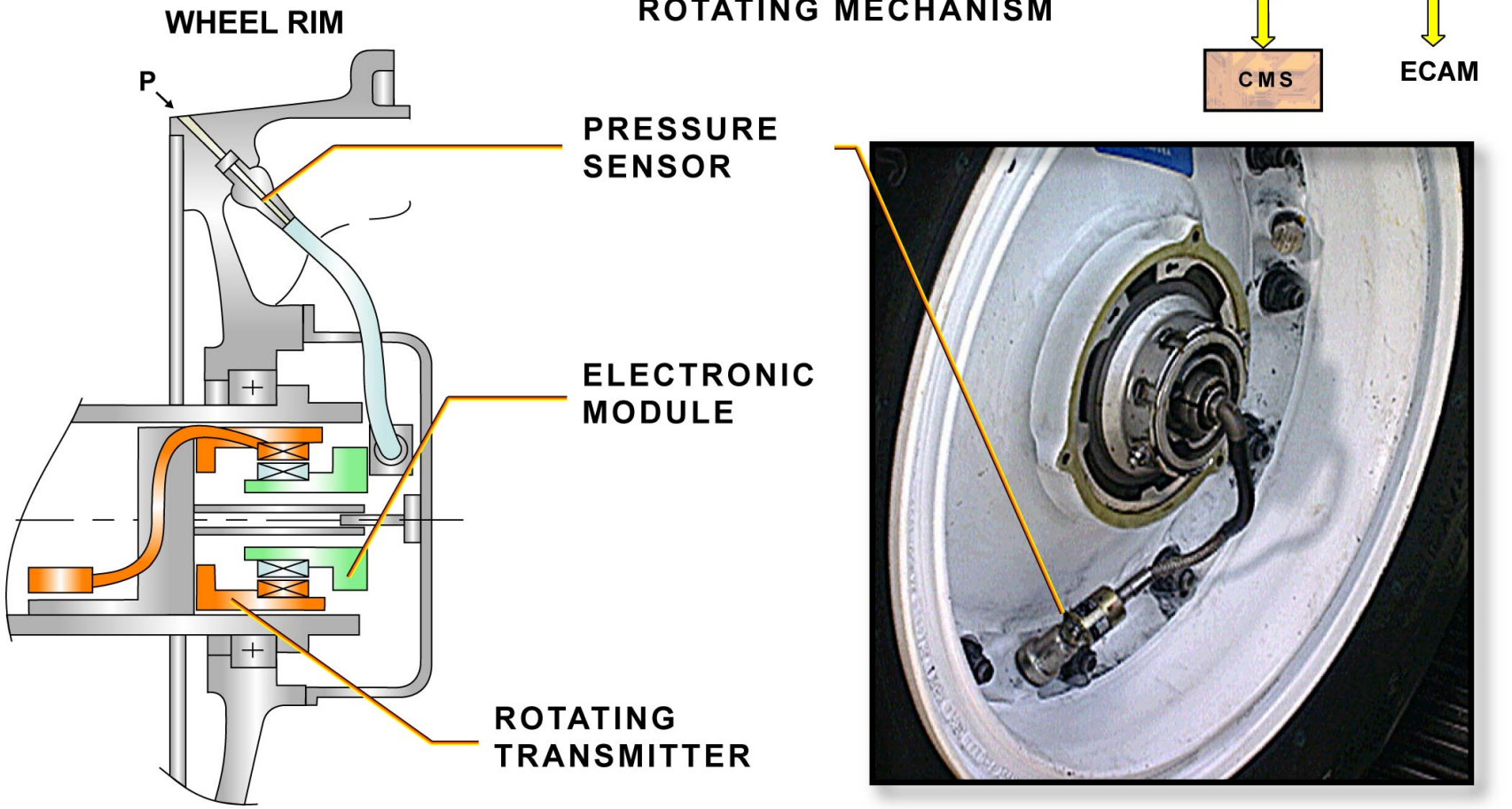


ROTATING MECHANISM



PURPOSE ... TPIC

NOSE WHEEL STEERING D/O (3)

GENERAL

The nose wheel steering (N/WS) system controls the direction of the A/C on the ground by acting on the position of the nose wheels (N/Ws) in relation to the A/C centerline, as a function of the relevant steering command. A dual system computer - the Braking/Steering Control Unit (BSCU) - controls and monitors the steering system. The steering system is supplied by the green hydraulic system.

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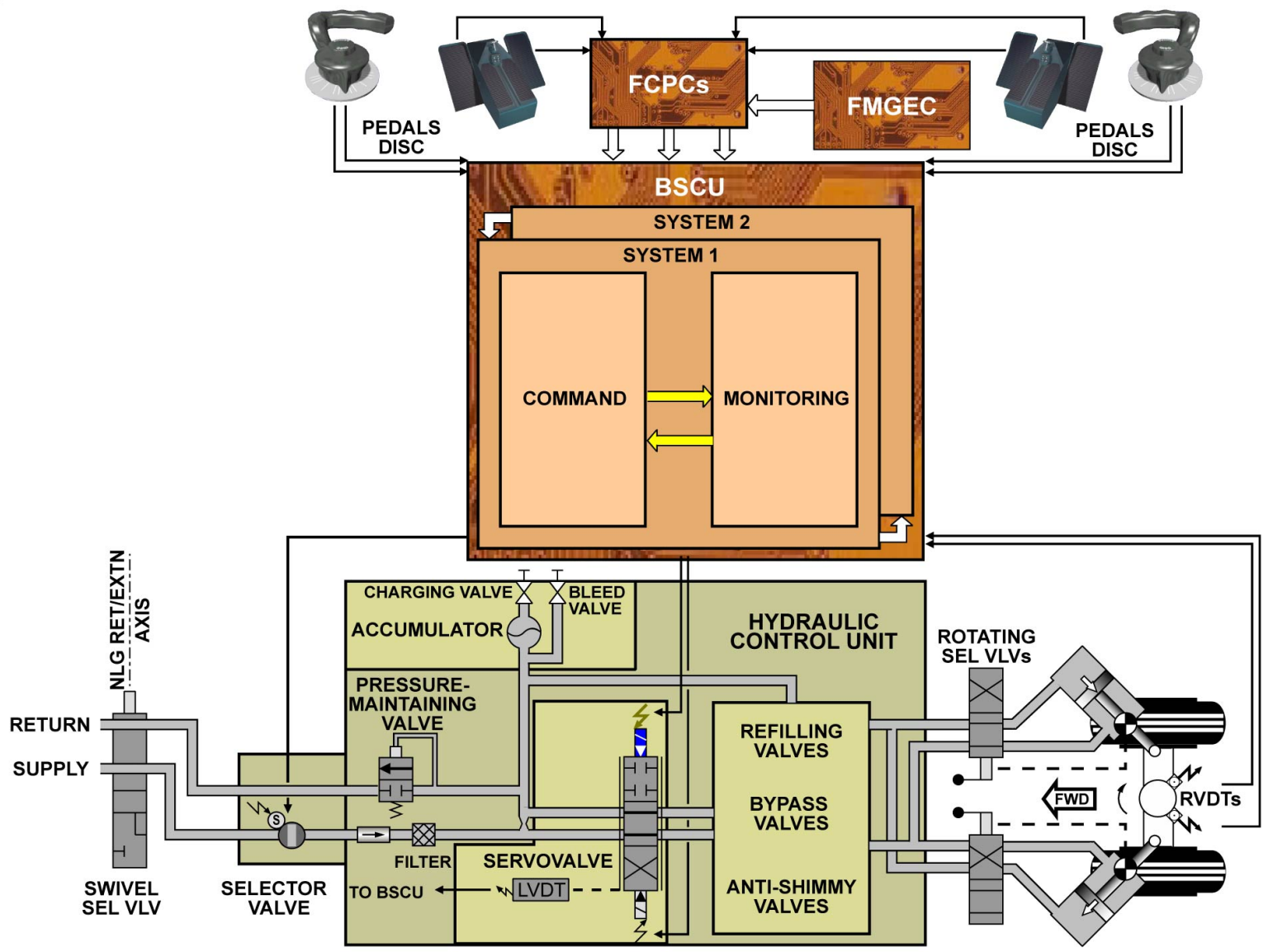

GENERAL

G9409341 - GAUT0T0 - FM32D8000000003

NOSE WHEEL STEERING D/O (3)

CONTROLS

Steering command inputs come from 3 independent sources: the dedicated steering handwheels, rudder pedals and the autopilot guidance orders. The steering angle decreases in proportion to the increase in the A/C speed. In case of simultaneous action, orders are added algebraically.

HANDWHEELS

The maximum steering angle using the handwheel is ±72° when the ground speed is less than 40 kt.

PEDALS AND AUTOPILOT

Steering orders from the pedals and the autopilot are sent to the BSCU via the 3 Flight Control Primary Computers (FCPCs). The maximum steering angle using the pedals and the autopilot is ±6° when the ground speed is less than 100 kt. When a pedal disc P/B is pressed in, N/WS by the pedals is disconnected.

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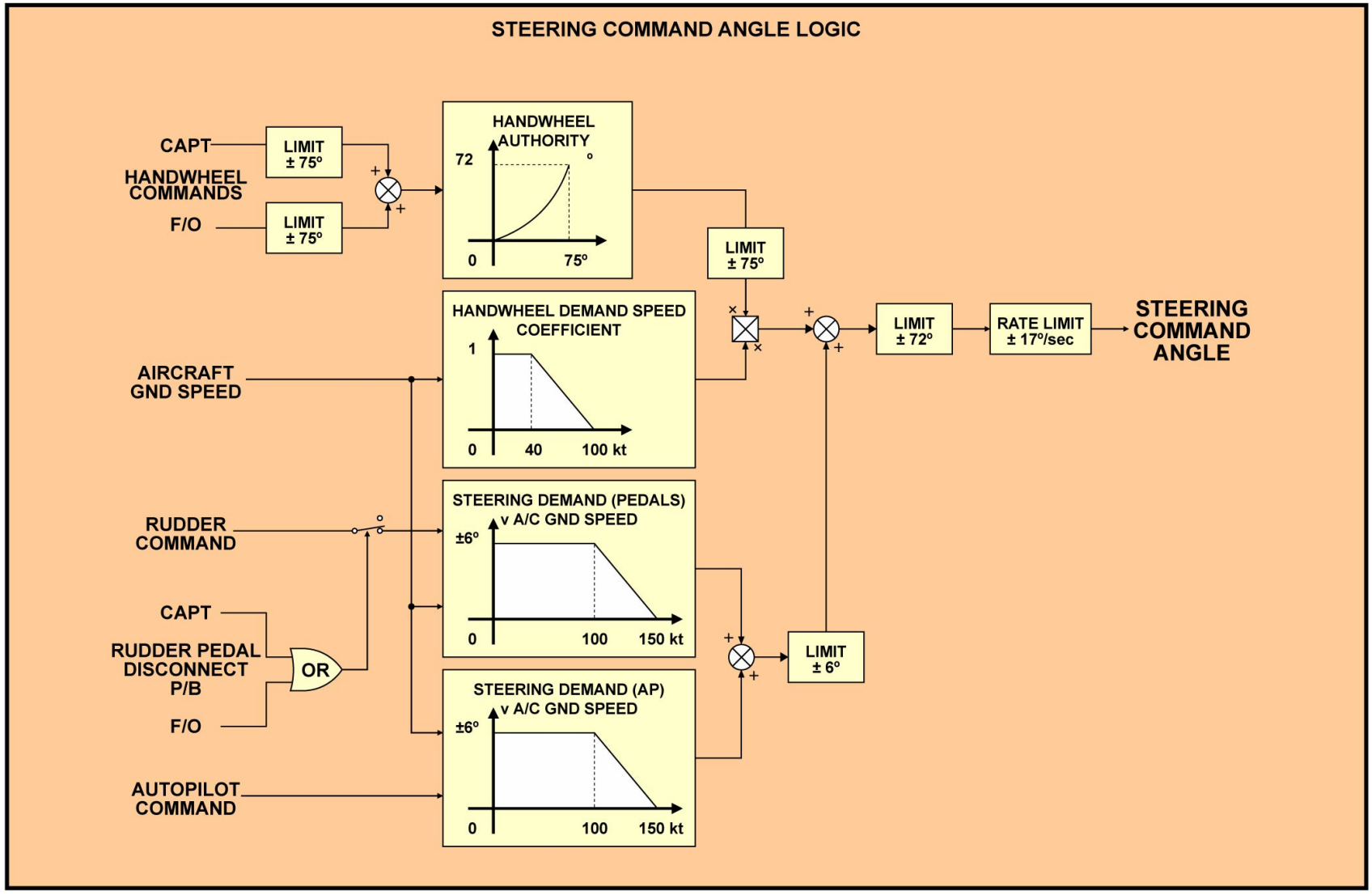

CONTROLS - HANDWHEELS & PEDALS AND AUTOPILOT

G9409341 - GAUT0T0 - FM32D8000000003

NOSE WHEEL STEERING D/O (3)

BSCU

The two systems of the BSCU are supplied independently. Each system is divided into two channels, a monitoring channel and a command channel. The command channel calculates and generates the command signals while the monitoring channel checks if the command channel is operating correctly. In order to maintain maximum steering system availability, the BSCU and most of its electrical peripherals are duplicated and segregated into system 1 and system 2. The two systems switch over automatically at each L/G down selection, or in case of system 1 or 2 failure.
The BSCU uses the steering inputs to calculate the required steering angle, the rate of movement and the direction to turn. It sends steering outputs to the electro-hydraulic components: selector valve and servovalve. The BSCU receives servovalve position feedback through its Linear Variable Differential Transducer (LVDT) and sliding tube position feedback through 2 Rotary Variable Differential Transducers (RVDTs) in order to servo-loop the steering function.

PRE-LANDING SELF TEST

In flight, after the L/G has extended, the BSCU does a test sequence to check the availability of the steering system. The test sequence checks the capability of the BSCU to control and monitor the correct operation of the selector valves and the servovalve and their inhibition in case of failure.

NOTE: Note that during the test sequence, commanded steering movements are checked and the nose wheels move slightly.

STEERING ACTIVATION LOGIC

The steering system is activated in steering mode when the conditions displayed on the screen are satisfied.

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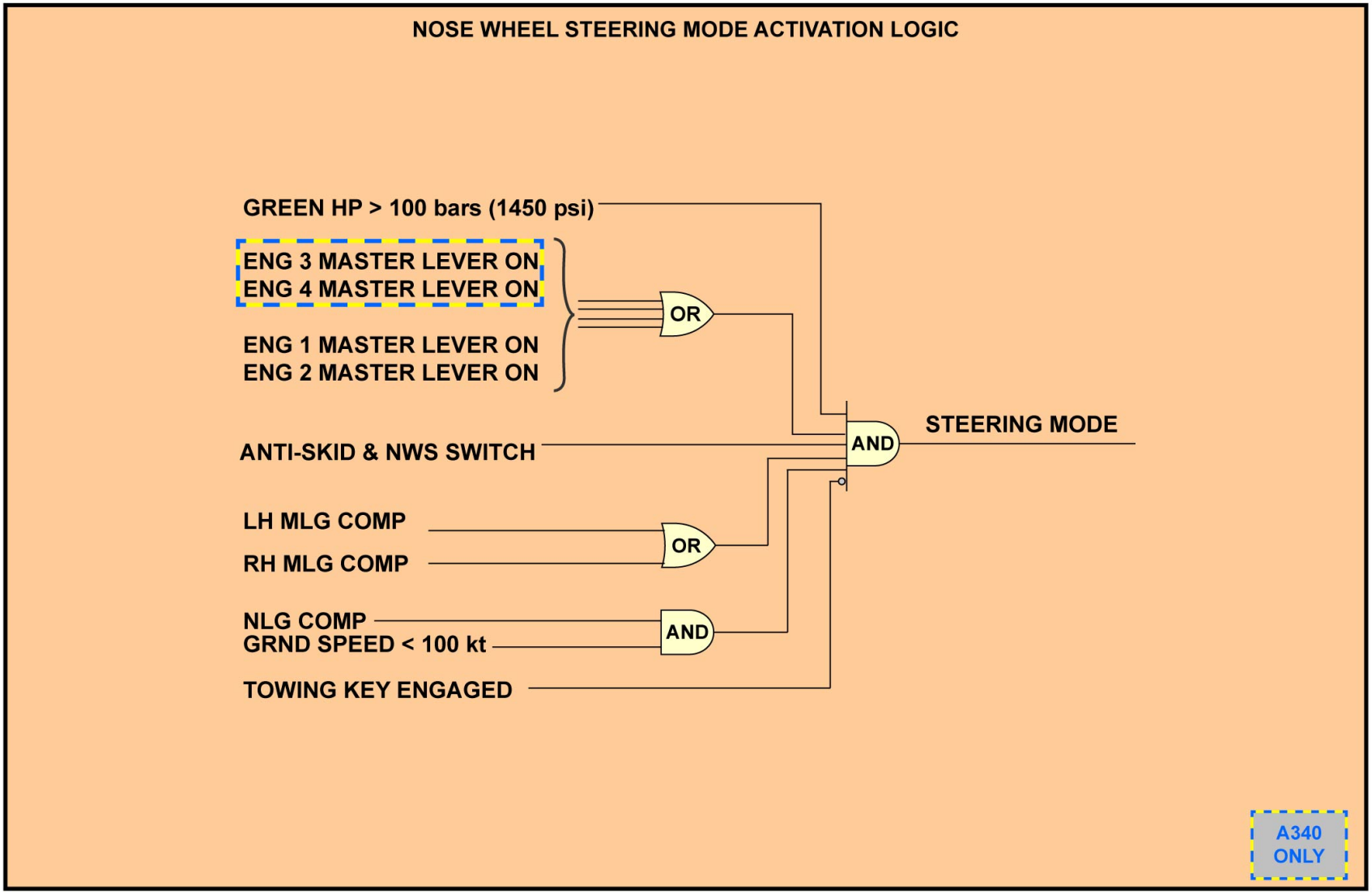

BSCU & STEERING ACTIVATION LOGIC

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NOSE WHEEL STEERING D/O (3)

MONITORING INTERFACES

Steering system data, such as fault indications and system status, is displayed on the EWD and the SD on the wheel page. Fault indications are stored in the BITE of the BSCU and are also reported to the Central Maintenance System (CMS).

OPERATION

In flight, the N/Ws are automatically driven to the center position by two cams on full extension of the shock absorber. When the shock absorber is pressed, the upper cam moves upward to disengage from the lower cam, and this lets the sliding member rotate. When the gear is extended, the swivel selector valve lets the hydraulic pressure pressurize the hydraulic control unit to the servovalve. When the Nose Landing Gear (NLG) is retracted, the swivel selector valve isolates the system from hydraulic pressure.
The selector valve is energized open when all the conditions are fulfilled. At touchdown, the BSCU lets hydraulic pressure be ported. The servovalve supplies the hydraulic pressure to the steering actuators in proportion to an electrical signal from the BSCU. This valve has two coils - each coil is connected to one system of the BSCU. The LVDT sends the data to the monitoring channel of the BSCU to give the correct position of the servovalve. The supply pressure is routed to the correct chamber of each steering actuator through the rotating selector valves. The RVDT monitors the correct angular position of the N/Ws and sends data to the command and monitoring channels of the BSCU.

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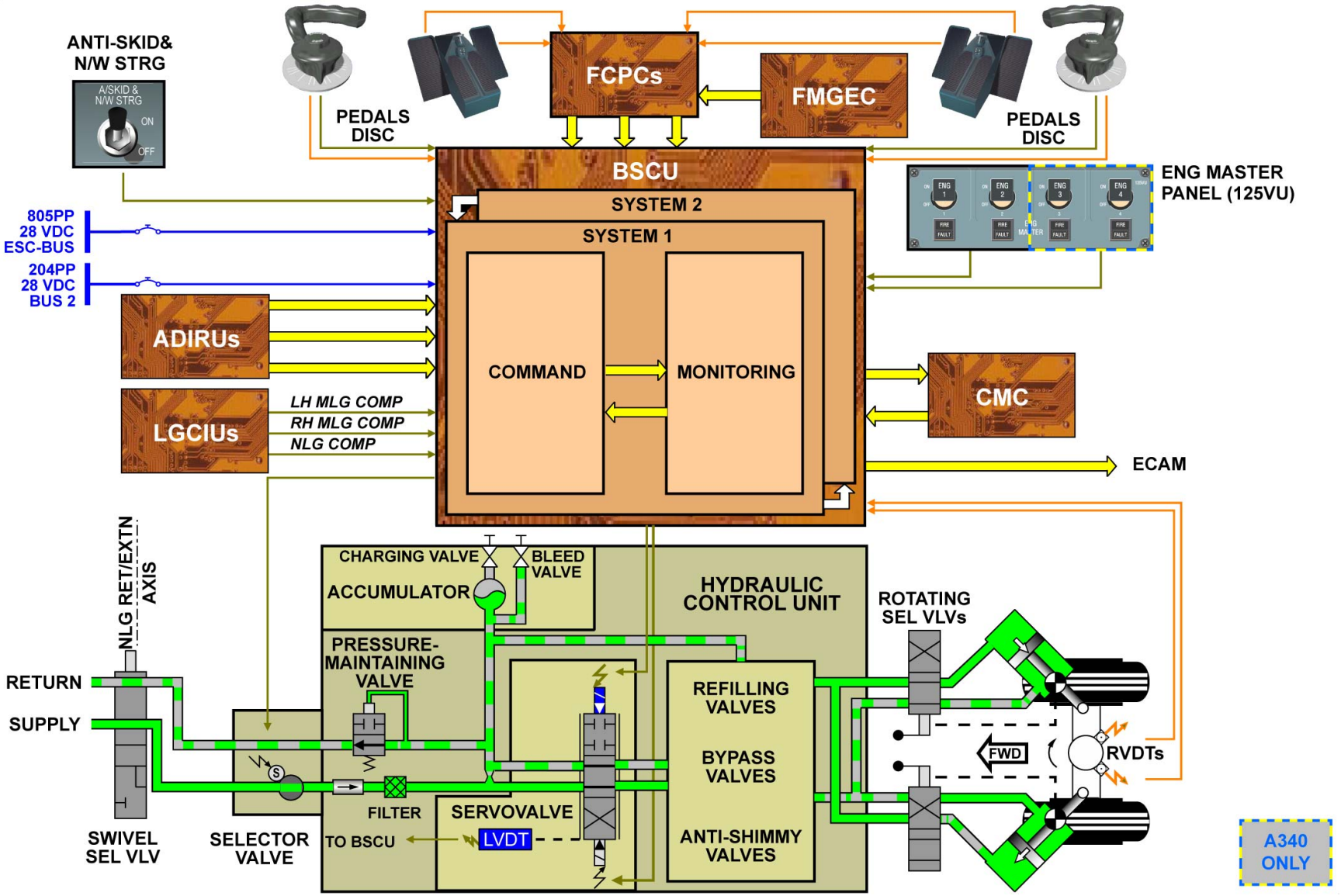

MONITORING INTERFACES & OPERATION

G9409341 - GAUT0T0 - FM32D8000000003

NOSE WHEEL STEERING D/O (3)

OPERATION (continued)

STEERING ACTUATOR MECHANISM

The mechanically-controlled rotating selector valves connect two service lines to their related steering actuator. Each service line is used either as a supply or return line, or is connected to the full bore or annulus end of the actuator as necessary. The configuration of the valve changes when the N/W moves past a certain angle. Thus, the service lines are always connected to the correct end of the actuator.

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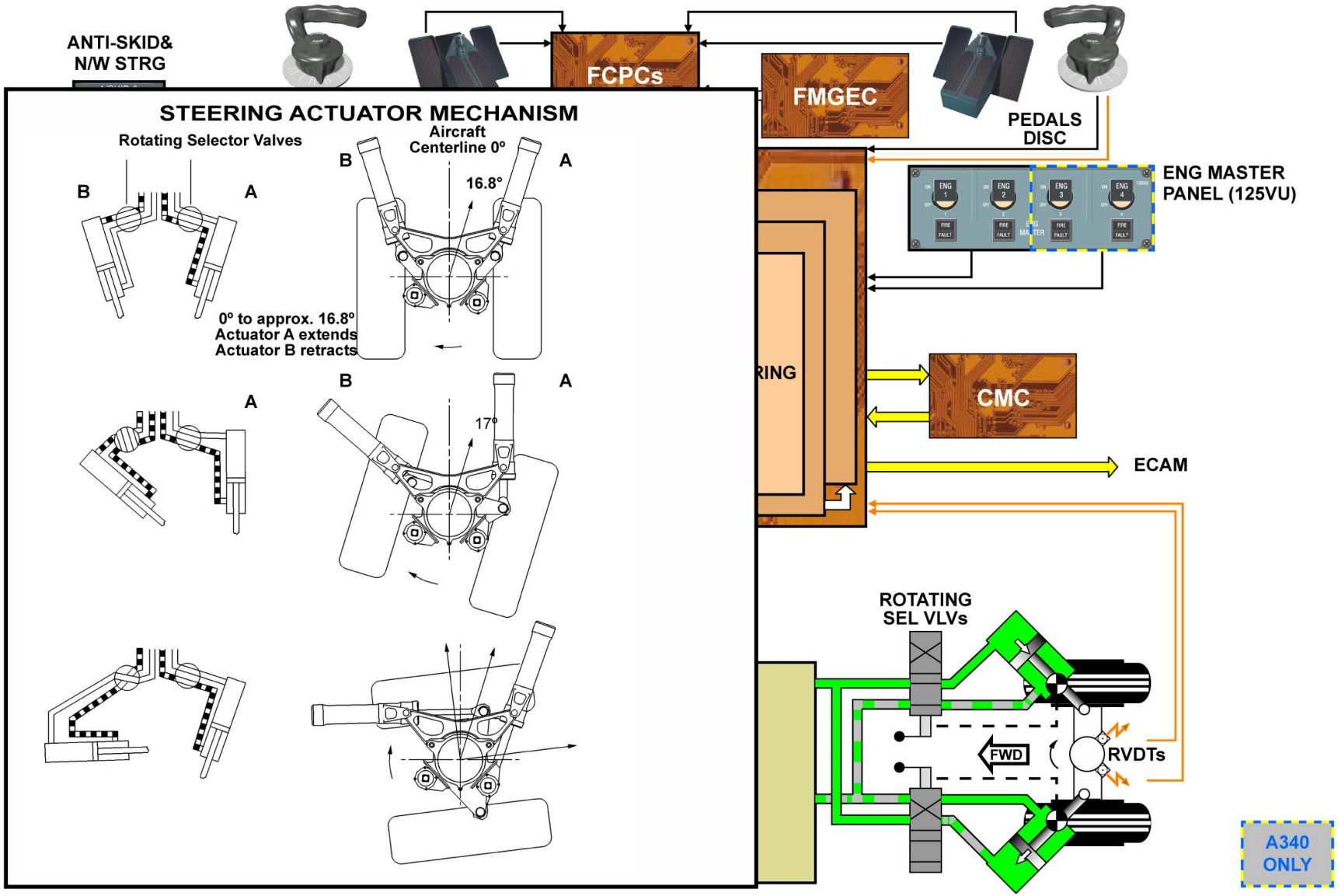

OPERATION - STEERING ACTUATOR MECHANISM

G9409341 - GAUT0T0 - FM32D8000000003

NOSE WHEEL STEERING D/O (3)

OPERATION (continued)

CASTORING AND SHIMMY DAMPING

In the event of either dual BSCU power supply loss, dual BSCU system failure or hydraulic system failure, N/WS can freely castor into the direction of A/C travel. When the N/W is castoring, a residual pressure of 15 bars (217 psi) is maintained in the system by the pressure-maintaining valve and the accumulator. The accumulator and the refilling valves prevent cavitation in the actuator chambers. The hydraulic fluid in the actuators can move from one actuator to the other through the anti-shimmy and by-pass valves. These valves operate to power the steering mode and to reduce the pressure. The anti-shimmy damping function is the same as in the powered steering mode.

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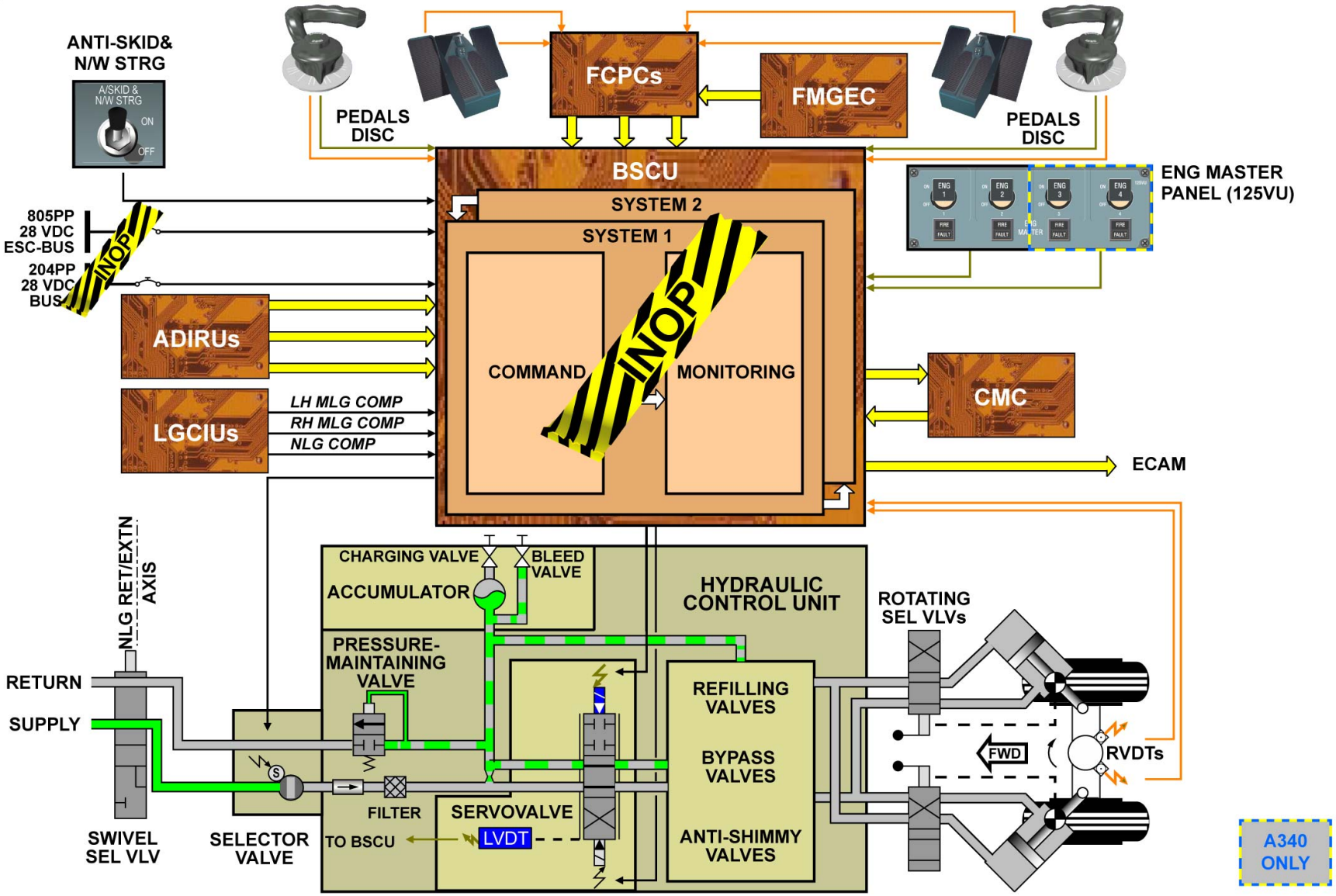

OPERATION - CASTORING AND SHIMMY DAMPING

G9409341 - GAUT0T0 - FM32D8000000003

NOSE WHEEL STEERING D/O (3)

TOWING

Towing of the A/C via the nose leg-towing bracket is done without any mechanical disconnection of the steering mechanism. The maximum authorized towing angle is ±65°. This avoids inducing excessive loads on the MLG during towing. Markings painted on the gear-driven NLG doors identify the maximum towing angle. A steering system deactivation facility, in the form of a lever-operated switch mounted on an electrical deactivation box on the NLG, is provided for ground crew use when the A/C has to be towed. This deactivates the steering control system to let the N/Ws castor and be freely rotated by the towing vehicle. In towing configuration, the lever must be secured by a safety pin. The control box also has an indicator light with a light check button, which is illuminated when the park brake handle is set to on.

NOTE: Note that the steering actuator mechanical stop of ±95° must not be reached.

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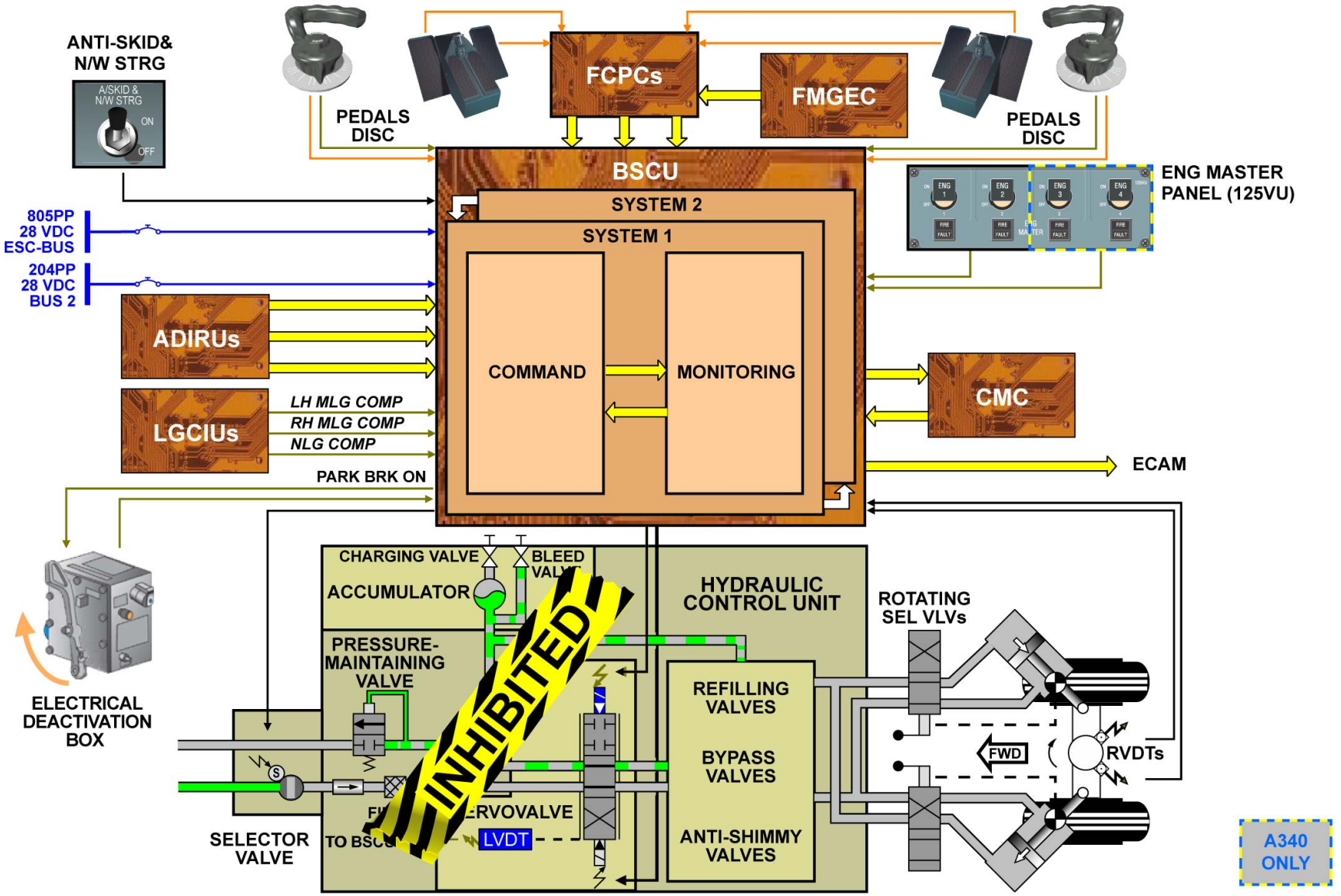
ANTI-SKID& N/W STRG
A/SKID & N/W STRG
ON
OFF
PEDALS DISC
FCPCs
FMGEC
PEDALS DISC
BSCU
SYSTEM 2
SYSTEM 1
COMMAND
MONITORING
ENG MASTER PANEL (125VU)
805PP 28 VDC ESC-BUS
204PP 28 VDC BUS 2
ADIRUs
LGCIUs
LH MLG COMP
RH MLG COMP
NLG COMP
PARK BRK ON
CMC
ECAM
ELECTRICAL DEACTIVATION BOX
CHARGING VALVE
BLEED VALVE
ACCUMULATOR
HYDRAULIC CONTROL UNIT
ROTATING SEL VLVs
PRESSURE-MAINTAINING VALVE
REFILLING VALVES
BYPASS VALVES
ANTI-SHIMMY VALVES
FWD
RVDTs
INHIBITED
SELECTOR VALVE
LVDT
A340 ONLY

TOWING

NOSE WHEEL STEERING D/O (3)

STEERING ANGLE PROTECTION

The NLG Steering Angle Protection System gives a visual warning of excess angular travel of the NLG steering during towing and pushback operations. In the warning condition, which operates at more than 93 degrees, it shows that possible damage can have occurred to the components of the NLG steering system. Two warning lights, one on the NLG and one on the flight deck, come on when this condition has occurred.

The system uses two proximity sensors, one installed on each side of the NLG, which operate with a single target. The target is attached below the upper attachment points of the torque links (which move with the direction of the nosewheel). When the target nears one of the sensors the warning lights operate. If the circuit operates, it stays latched on until the cockpit push-button is reset. The circuit can only be reset with the a/c power supplies connected.

The system power is supplied from the aircraft or the towing tractor. Discrete signals from the Landing Gear Control and Interface Units (LGCIUs) control the a/c power supplies to the system.

NOTE: When a standard tow bar is used (that has shear pins) the NLG Oversteer warning can be ignored only if the shear pins are not damaged. If the shear pins are sheared or damaged, an inspection of the NLG must be completed.

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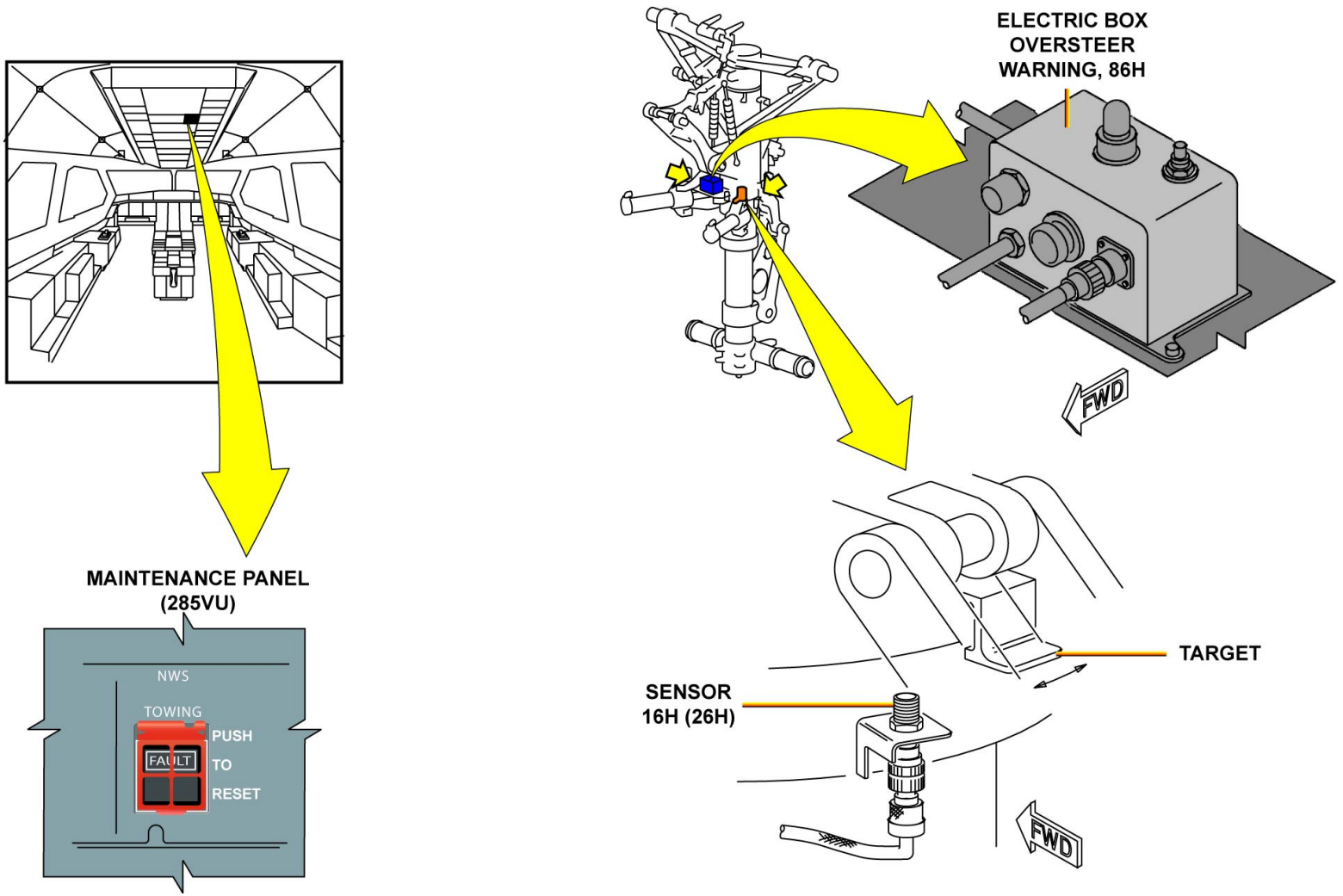

STEERING ANGLE PROTECTION

LANDING GEAR MCDU PAGES (2)

EXTN/RETRN

Selecting EXTN/RETRN enables direct access to the EXTENSION/RETRACTION main menu.
All LGCIU main menus are identical.
As well as the standard CMS functions, the LGCIU menu includes a specific page.
The LGCIU SIMULATION function is displayed on the second MCDU screen, which is accessible through the scrolling keys.
Using the first left key enables access to the LANDING GEAR SIMULATION.
Using the second left key enables the LANDING GEAR SIMULATION to be confirmed.
The display shows the available alternative configuration. A selection of the related MCDU key starts the simulation sequence.
During the L/G simulation, the selected LGCIU :
- disables its outputs to the L/G and door selector valves.
- Continues to output the correct data for the L/G not selected.

This function lets the LGCIU BITE circuits send specific output signals. These output signals relate to the flight or ground configuration and to the uplocked or downlocked configuration of each landing gear.
The line key symbol "<" shows the configuration that can be set. When there is no symbol "<", this shows the configuration that is set.
The initial configuration always shows the ground configuration.

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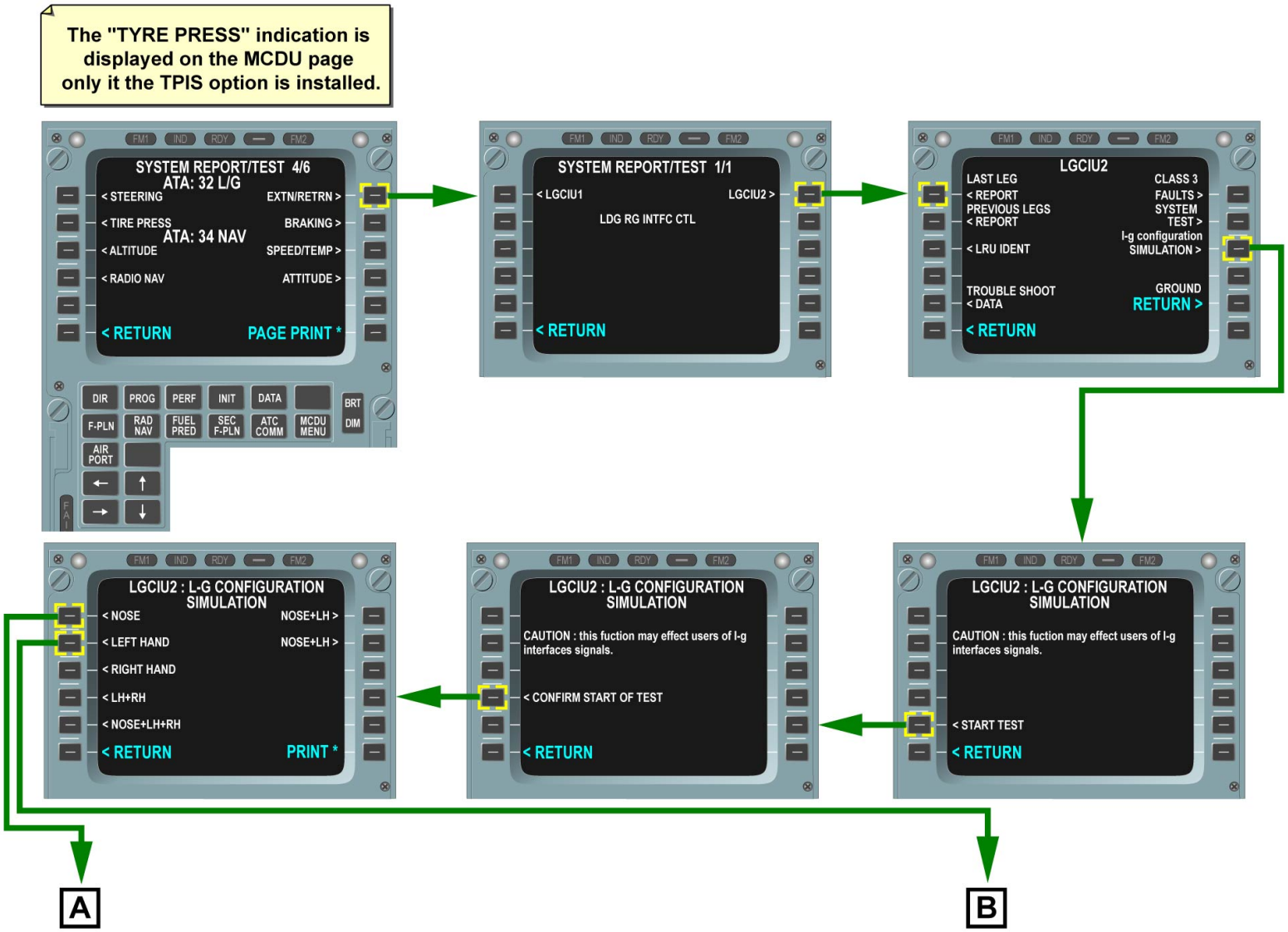

EXTN/RETRN

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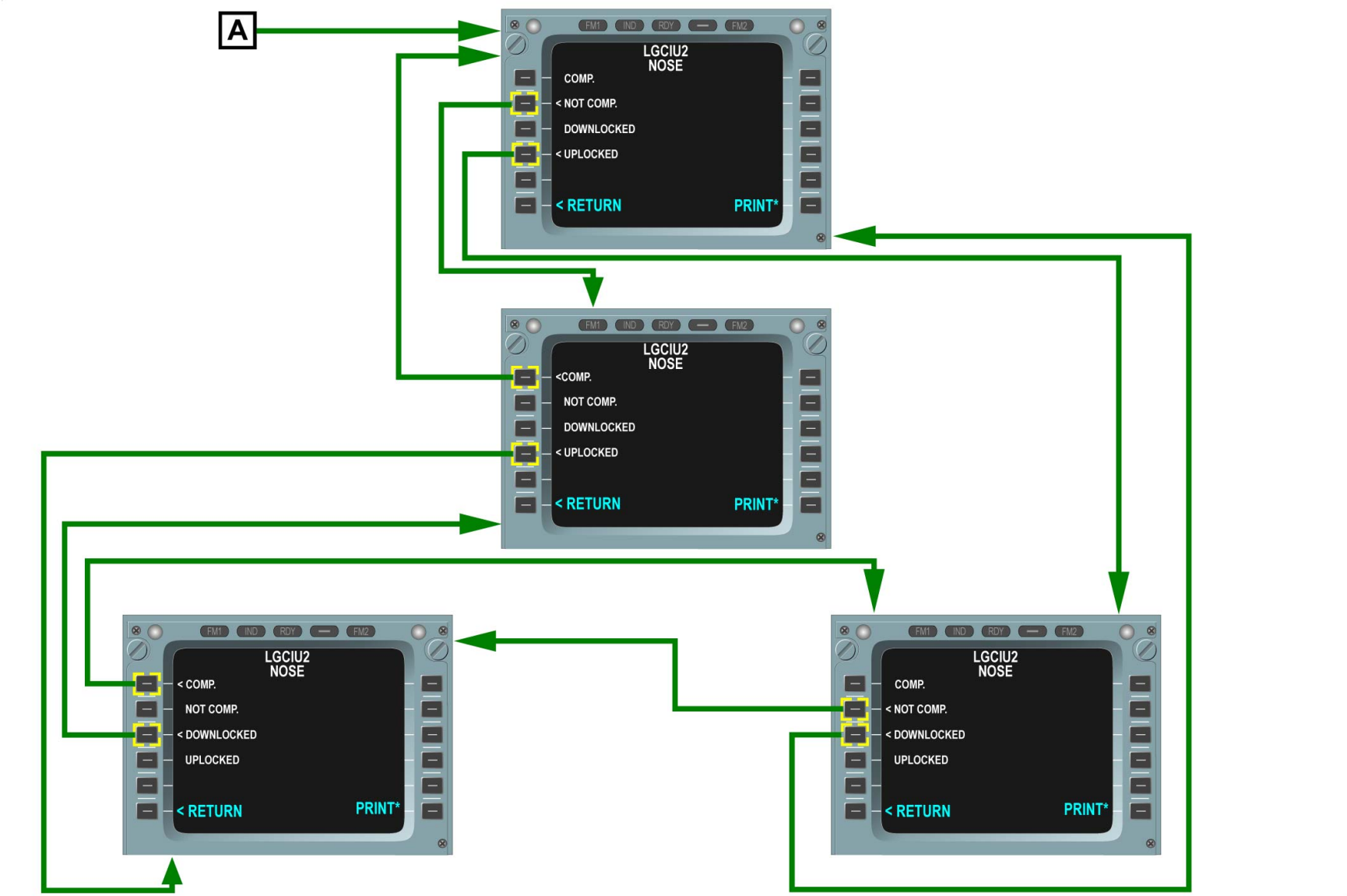

EXTN/RETRN

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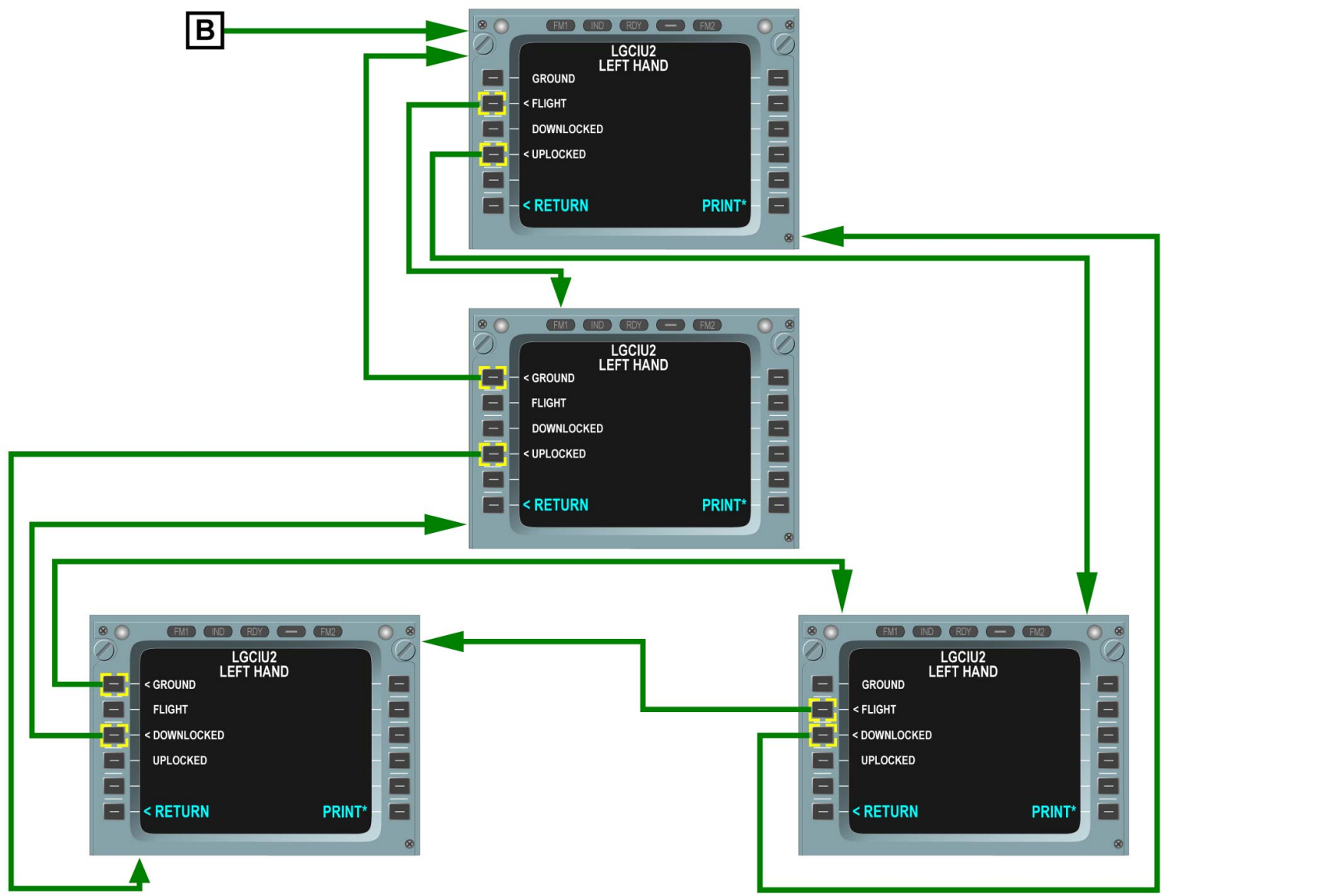


EXTN/RETRN

G9409341 - GAUT0T0 - FM32P7MCDUTST02

PUSH BACK AND TOWING (2)

PUSH BACK AND TOWING: VIDEO

This film presents the procedure for push back and towing with the nose landing gear of the A330 in normal condition. For the A340 the procedure is similar.

PUSH BACK

Make sure that the safety pins are installed on the nose, the main and the centerline gear. After the cockpit checks, energize the aircraft electrical circuits following the AMM procedure by using external power or by starting the APU. Then set batteries 1 and 2 to ON. Check the brake accumulator pressure on the triple indicator. The pointer in the green range indicates that a minimum of seven brake applications can be performed. If the pressure is too low, you have to pressurize the system through the blue electrical pump. Ask for clearance then pressurize the blue hydraulic system. When the pressure is correct, switch off the blue electrical pump. Apply the parking brake and start the APU. The ground mechanic sets the towing lever to the towing position and installs the pin. Before you install the towbar make sure that the dimension "H" is correct. Attach the towbar to the nose gear fitting.

Make sure that the towbar is equipped with:

- a damping system,
- a traction shear pin calibrated at the required value,
- a torsion shear pin calibrated at the required value.

Connect the tractor to the towbar. Carry out an inspection around the aircraft. Make sure that the area is clear. Make sure that the engine cowls are properly locked, all the doors are closed and the gear doors are closed. Remove the main wheel chocks. Disconnect the external power. Contact the cockpit so that the operator asks for clearance. In the cockpit, select VHF on the control and monitoring radio panels. Contact Air Traffic Control to request push back and towing and wait for their authorization. Set the NAVIGATION lights, BEACON lights and LOGO lights to ON. When ready, contact the ground operator. When authorized by the ground operator, release the parking brake and check the triple indicator. When the brake is OFF, the ground operators start the push back operation. Push the aircraft smoothly and slowly. If you push or tow the aircraft in an area with nearby obstacles, two operators are required at the wing tips. The maximum towing angle, left and right, is indicated by a red mark painted on the nose gear fixed door. A steering angle protection system will activate an oversteer warning light if the steering angle exceeds a predetermined value. If exceeded, an inspection of the nose landing gear has to be carried out according to the AMM procedure. If you push or tow the aircraft with the engines at IDLE, the maximum steering angle is 40 degrees on each side to avoid nose landing gear slippage. When the push back operation is completed, make sure that the nose wheels are aligned with the aircraft centerline. If not, tow the aircraft as required. In the cockpit, apply the parking brake and check the triple indicator. The towbar can be disconnected.

TOWING

During the towing operation, communications between the tractor and the cockpit can be ensured by the headset or through a VHF radio. Once in position, make sure that the nose wheels are aligned with the aircraft centerline. Inform the cockpit that the parking brake can be applied. In the cockpit, apply the parking brake and check the triple indicator. Inform the ground operator that the brake is applied, switch off the lights and set the radio to OFF. Put the wheel chocks in position. Disconnect the tow bar. Disconnect the headset. Remove the steering pin. The push back and towing operation is completed. Put the aircraft in the configuration related to the next operation.

G9409341 - GAUT0T0 - FM32P900000001

PUSH BACK AND TOWING: VIDEO - PUSH BACK & TOWING

LANDING GEAR SYSTEM BASE MAINTENANCE (3)

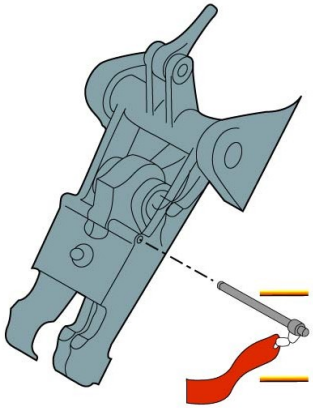
INTRODUCTION

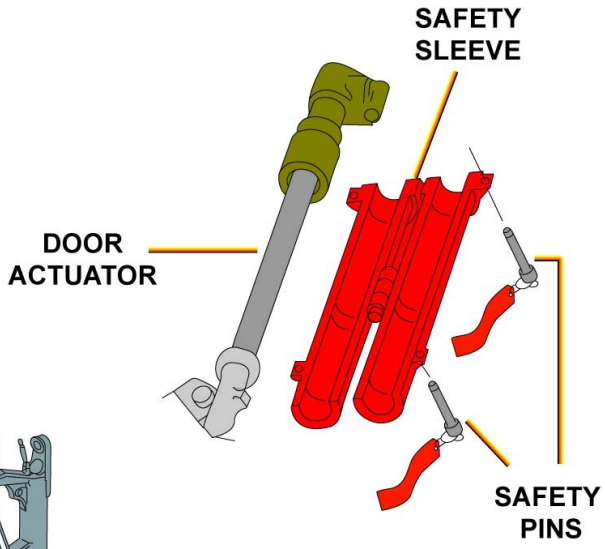
This module will highlight the gas and fluid replenishment applicable to the L/G shock absorbers.

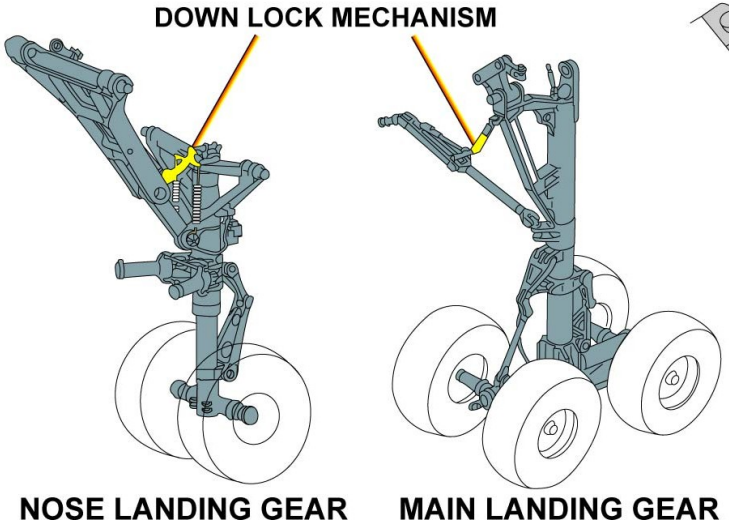
WARNING: MAKE SURE THAT THE SAFETY DEVICES AND THE WARNING NOTICES ARE IN POSITION BEFORE YOU START A TASK ON OR NEAR:
- THE FLIGHT CONTROLS,
- THE FLIGHT CONTROL SURFACES,
- THE L/G AND THE RELATED DOORS,
- COMPONENTS IN MOTION.

MOTION OF COMPONENTS CAUSES DEATH OR INJURY TO PERSONS.
MAKE SURE THAT THE GROUND SAFETY-LOCKS ARE CORRECTLY INSTALLED ON THE L/G AND ON THE L/G DOORS.
USE SOLVENTS AND CLEANING AGENTS IN WELL-VENTILATED AREAS.
DO NOT GET IN CLOSE CONTACT WITH COMPRESSED GAS. GAS CAN CAUSE INJURY AND CONTAMINATE YOUR BLOOD AND CAUSES DEATH.

G9409341 - GAUT0T0 - FM32Y2BASEMCE03







INTRODUCTION

G94093341 - GAUT0T0 - FM32Y2BASEMCE03

LANDING GEAR SYSTEM BASE MAINTENANCE (3)

GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

Put a warning notice in the cockpit to tell personnel not to operate the L/G controls.
Make sure that the green hydraulic system is depressurized.
Make sure that the safety devices are installed on the MLG.
Open the MLG doors and fit the MLG door safety devices.

CAUTION: DO NOT INFLATE THE MLG SHOCK ABSORBER AT THE LOWER VALVE. IF YOU USE THE LOWER VALVE, HYDRAULIC FLUID WILL ESCAPE.

Measure and write down the shock absorber dimension H.
Measure and write down the surface temperature of the aluminum piston adjacent to the bleed inflation valve.
Use the inflation chart to find out the correct pressure from the temperature and dimension H measurements you have just recorded.
Connect the charging equipment to the upper bleed/inflation valve and read the pressure on the pressure gauge.
If the measured pressure is lower than the inflation chart pressure, the shock absorber must be inflated. If it is higher, the shock absorber must be deflated.
If the dimension H changes during the adjustment, the procedure must be repeated from the beginning.
Remove the Ground Support Equipment (GSE), special tooling and access platform. Remove all warning notices.

GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

- ✓ - Warning notice is put in the cockpit.
- ✓ - Green hydraulic system is depressurized.
- ✓ - Safety devices are installed on the MLG.
- ⇨ - MLG doors are open and fitted with safety devices.

...

Procedure

...

Gas replenishment of the MLG shock absorber

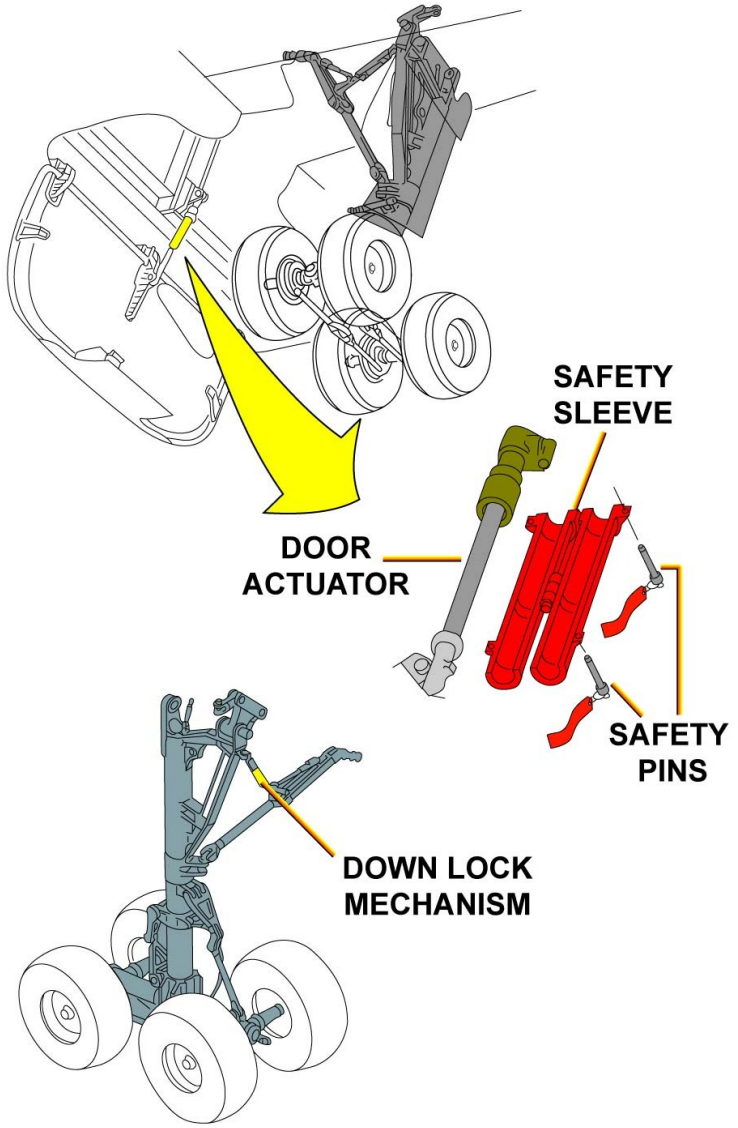
...

Close-up

...

L/G LEVER (312VU)

GREEN HYD. SYSTEM (DEPRESSURIZED)



GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

...

✓ **Job set-up**

...

✓ **Make sure that:**

...

⇨ **Procedure**

...

⇨ **Gas replenishment of the MLG shock absorber**

✓ - CAUTION: DO NOT INFLATE AT THE LOWER VALVE.

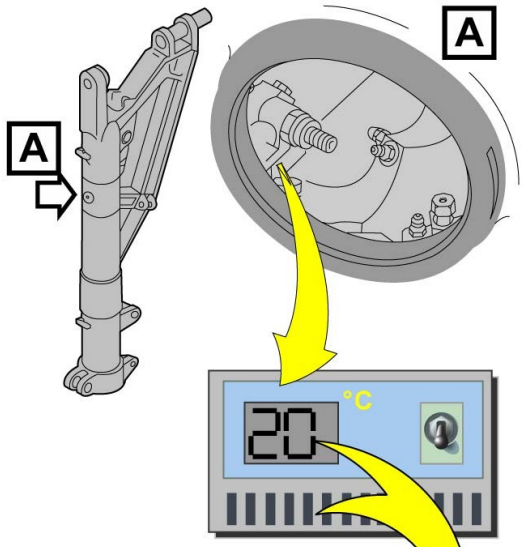
✓ - Measure and write down dimension H.

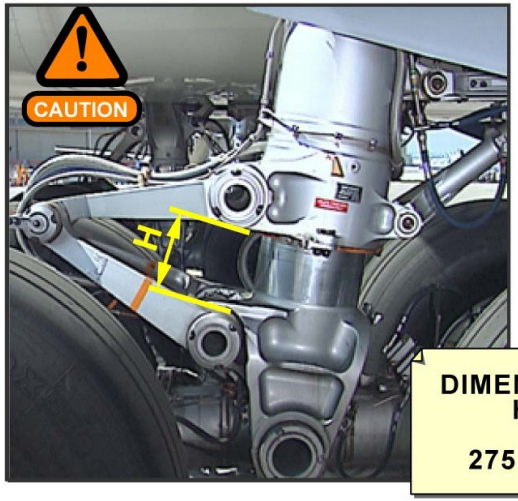
✓ - Measure and write down temperature.

⇨ - Determine the pressure using the inflation chart.

...

...





DIMENSION H

275 mm

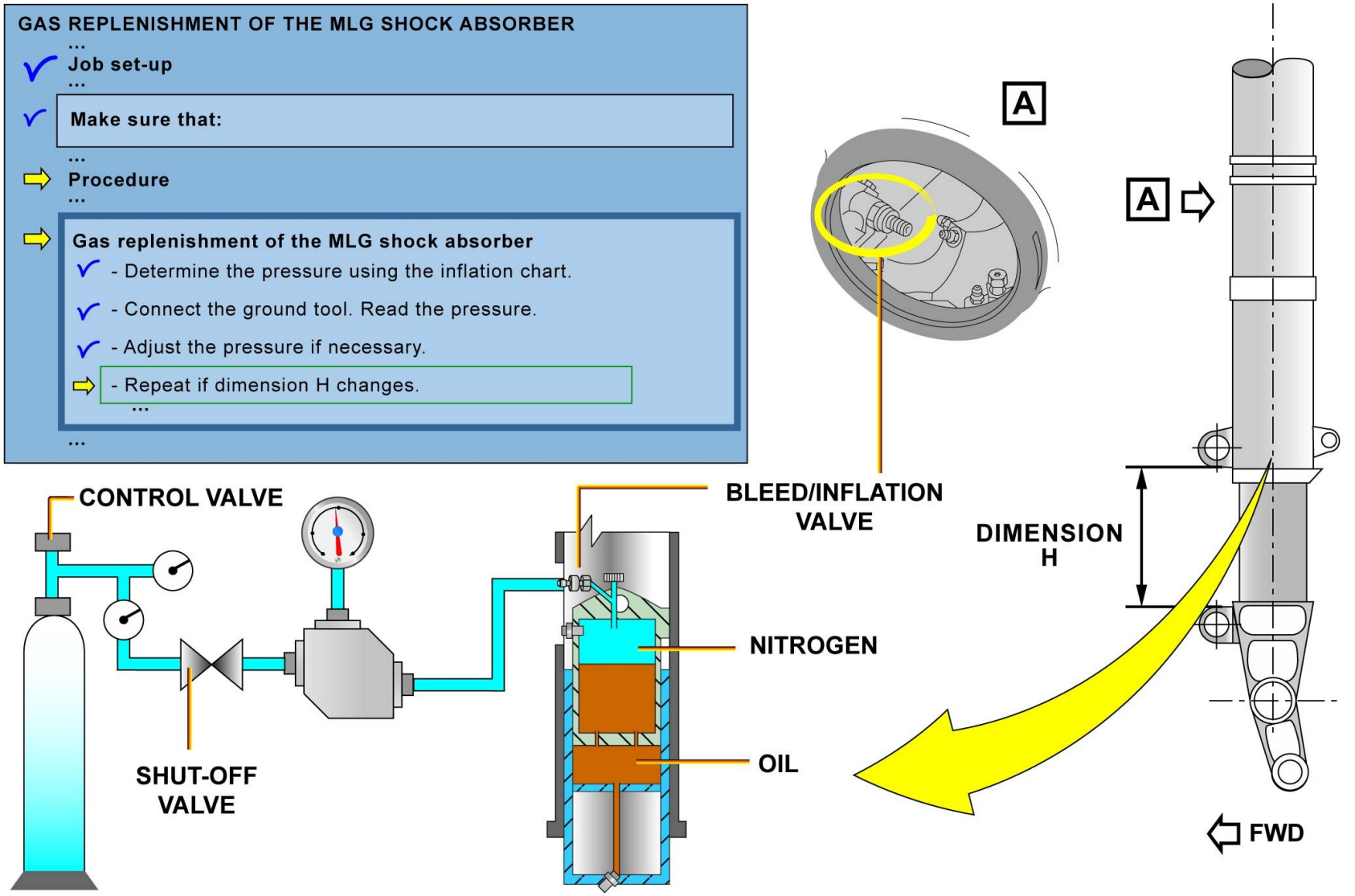
TEMP °C	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30
H (mm)	GAUGE PRESS (bar)												
275	68	70	73	75	78	81	83	86	89	92	95	98	101

The inflation chart gives:

95 bars

GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03



GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

...

✓ Job set-up

...

✓ Make sure that:

...

✓ Procedure

...

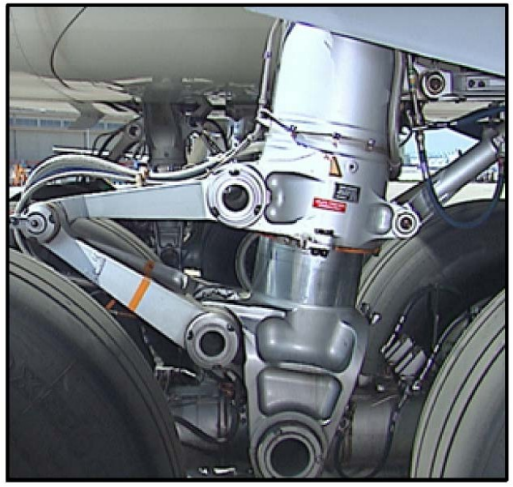
✓ Gas replenishment of the MLG shock absorber

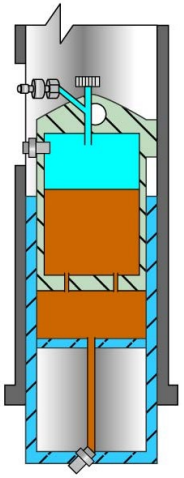
...

✓ Close-up

...

✓ - Remove tools, access platform and warning notices.





TASK COMPLETED

✓

GAS REPLENISHMENT OF THE MLG SHOCK ABSORBER

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G9409341 - GAUT0T0 - FM32Y2BASEMCE03

LANDING GEAR SYSTEM BASE MAINTENANCE (3)

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

Make sure the NLG wheels are central to the A/C axis.
Put warning notices in the cockpit to inform personnel not to operate the L/G and the nosewheel steering controls.
Make sure that the green hydraulic system is depressurized.
Deactivate the nosewheel steering.
Open the NLG doors and fit the NLG door safety devices.
Make sure that the bottom chamber pressure is at least 6.9 bars (100 PSI) higher than the top chamber pressure.
Measure and write down the shock absorber dimension H.
Measure the ambient temperature.
Adjust nitrogen pressure until the dimension H agrees ±1 mm with the top chamber pressure and the ambient temperature as shown in the graphic.
Make sure that the bottom chamber pressure is still at least 6.9 bars (100 PSI) higher than the top chamber pressure.
If measured top chamber pressure is higher than nominal top chamber pressure shown on the graphic, deflate at the top chamber bottom port, and adjust the dimension H as seen before.
Now, the pressures in the top and bottom chambers are adjusted. Check again that the bottom chamber pressure is at least 6.9 bars (100 PSI) higher than the top chamber pressure. If not, repeat the procedure.
Pressurize the green hydraulic system and make sure that the NLG wheels are still in the central position. Reactivate the nosewheel steering.
De-pressurize the green hydraulic system, remove the placards, tooling and equipment. Remove the safety devices from the NLG doors and close the doors.

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

✓ - Nose Landing Gear (NLG) wheels are aligned.

✓ - Warning notices are put in the cockpit.

- Green system is depressurized.

- ...

...

Procedure

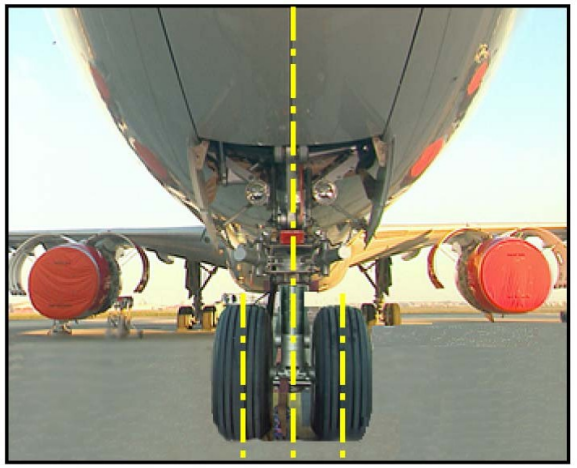
...

Gas replenishment of the NLG shock absorber

...

Close-up

...



GREEN HYD. SYSTEM (DEPRESSURIZED)

L/G LEVER (312VU)

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

✓ - Green system is depressurized.

✓ - Deactivate nosewheel steering.

- Open NLG doors. Fit safety devices.

...

Procedure

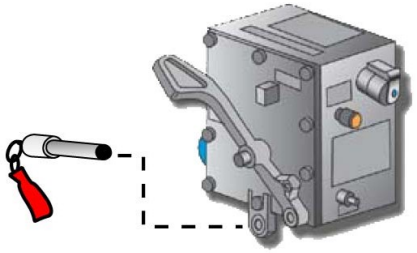
...

Gas replenishment of the NLG shock absorber

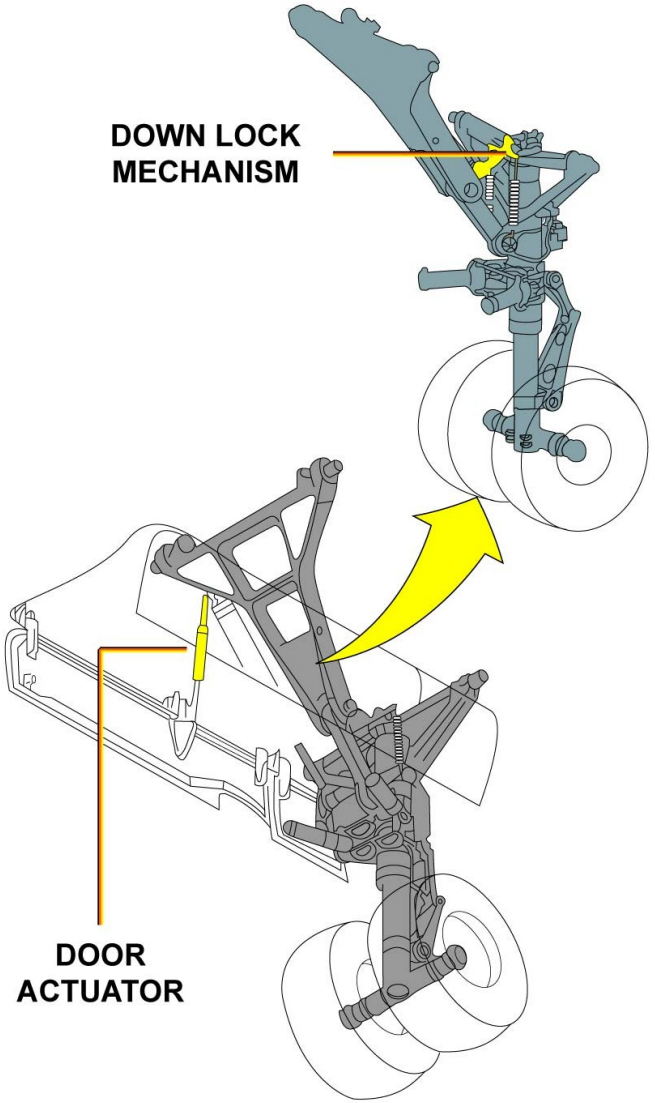
...

Close-up

...

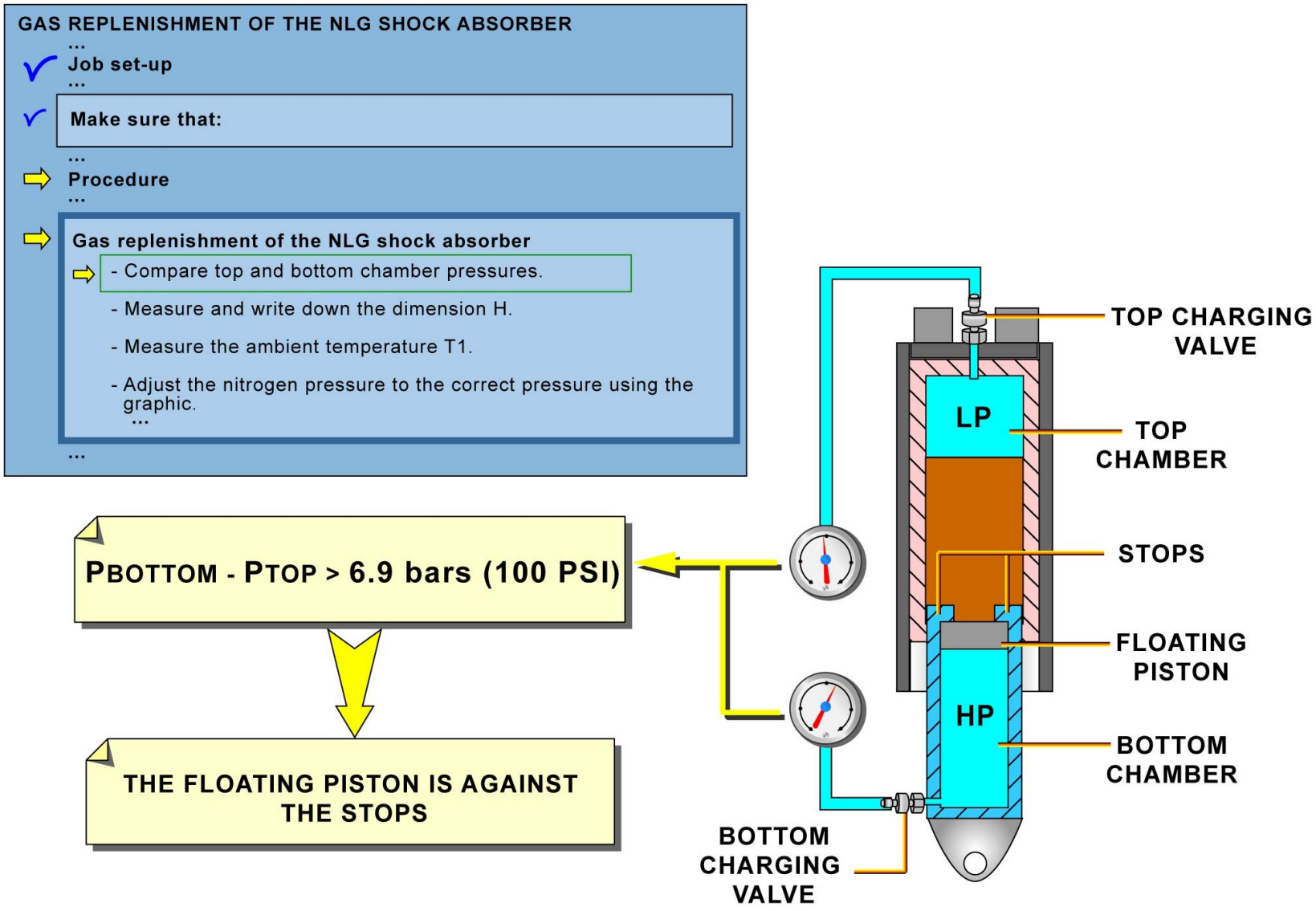


NOSEWHEEL STEERING
DEACTIVATION BOX



GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03



GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

✓ Job set-up

...

✓ Make sure that:

...

⇨ Procedure

...

⇨ Gas replenishment of the NLG shock absorber

✓ - Compare top and bottom chamber pressures.

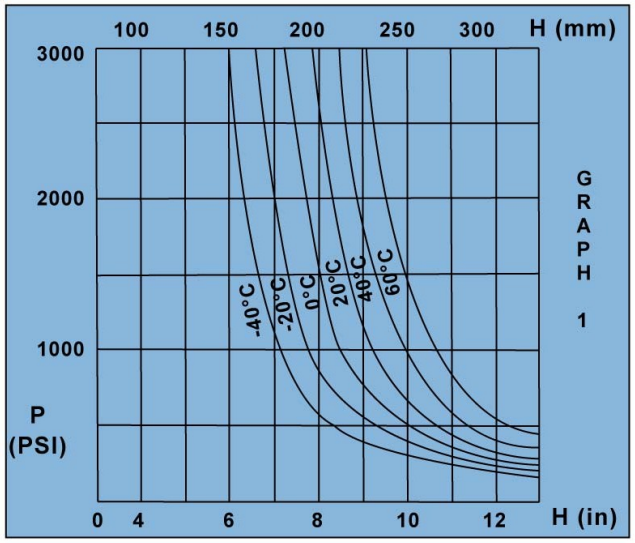
✓ - Measure and write down the dimension H.

✓ - Measure the ambient temperature T1.

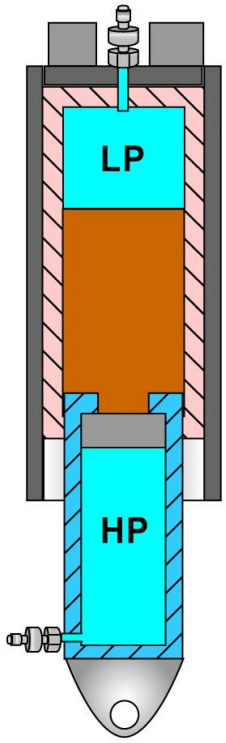
⇨ - Adjust the nitrogen pressure to the correct pressure using the graphic.

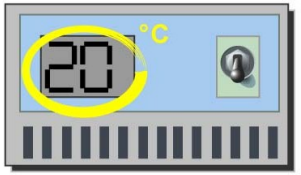
...

...

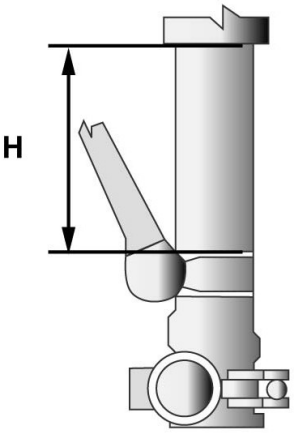


Adjust top chamber pressure (P1) until H agrees ±1 mm with H shown on the graphic

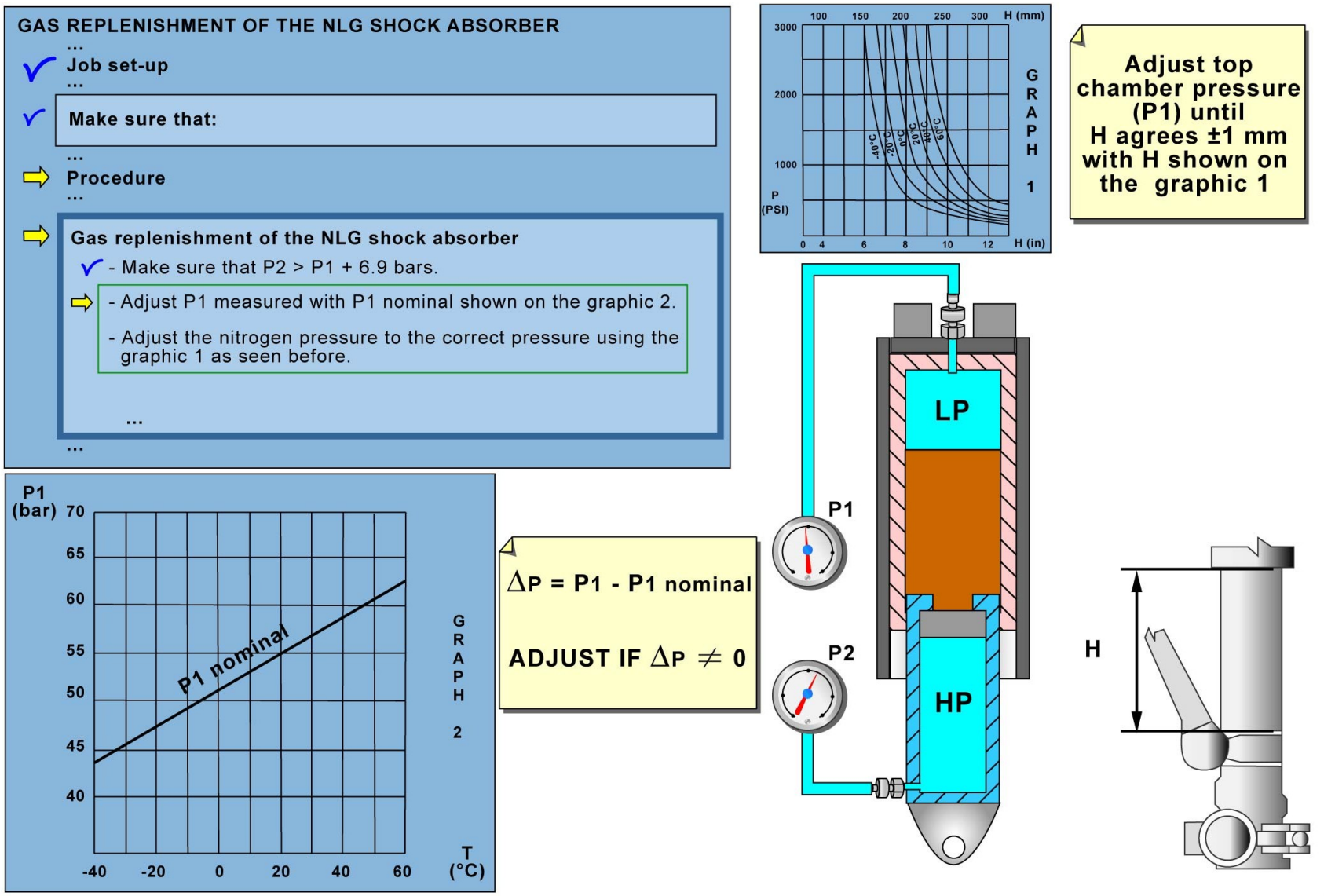




Ambient Temperature T1



GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER



GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

✓ Job set-up

...

✓ Make sure that:

...

✓ Procedure

...

✓ Gas replenishment of the NLG shock absorber

...

✓ - Check the pressure in both chambers.

✓ - Pressurize green system, check if wheels are in central position.

...

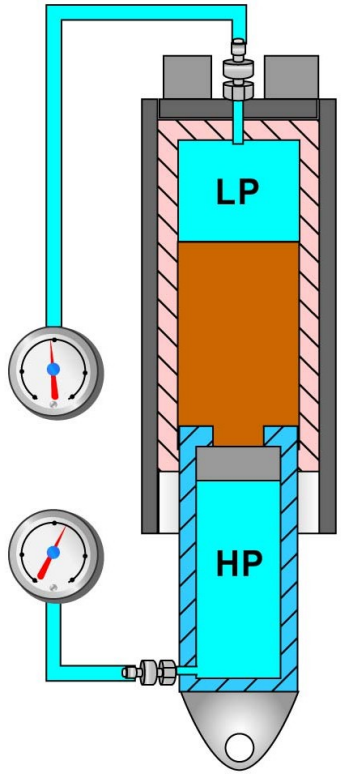
✓ Close-up

...

✓ - Remove safety devices and close the doors.

REPEAT ALL THE PROCEDURE IF:

$P_{bottom} - P_{top} < 6.9$ bars (100 PSI)



✓ TASK COMPLETED

GAS REPLENISHMENT OF THE NLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

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G9409341 - GAUT0T0 - FM32Y2BASEMCE03

LANDING GEAR SYSTEM BASE MAINTENANCE (3)

HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

Place a warning notice in the cockpit to prevent L/G operation and at the access panel to prevent MLG ground door opening.
Make sure the green hydraulic system is depressurized.
Put the MLG safety devices. Make sure that the applicable MLG door is closed.
Open the bleed screw. Install a bleed tube to the 3-way valve connected to the bleed/inflation valve. The free-end of the tube should be at least 400 mm below the valve.
Check the pressure control valve is closed, and open the bleed/inflation valve. Wait for 2 hours, to make sure that there is a complete nitrogen/fluid separation, and close the bleed screw.
Connect the hydraulic source to the filling valve via a shut-off valve.
Connect the secondary bleed valve to the container and open it. Pump the fluid from the hydraulic source up to a pressure of 1.7 bars (25 PSI).
Let the fluid bleed through the secondary valve until 5 liters of air-free fluid has flown down. Close the secondary bleed valve.
When the fluid from the bleed/inflation valve is free from air, close the filling valve and the shut-off valve. 10 minutes later, close the bleed/inflation valve.
Remove the bleed tubes, the container and the hydraulic supply line.
After fluid replenishment, the shock absorber must be serviced with nitrogen.
Remove the warning notices and safety devices.

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

- ✓ - Warning notices are in position.
- ✓ - Green system is depressurized.
- ⇨ - Safety devices are installed on MLG.
- - MLG doors are closed.

...

Procedure

...

Hydraulic replenishment of the MLG shock absorber

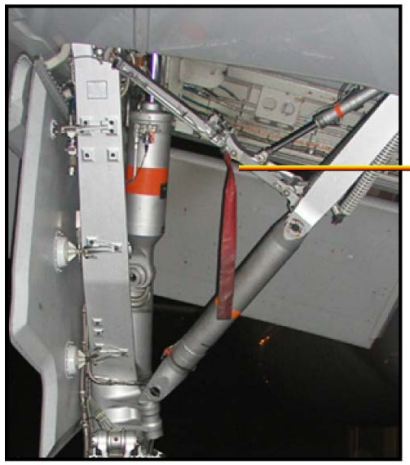
...

Close-up

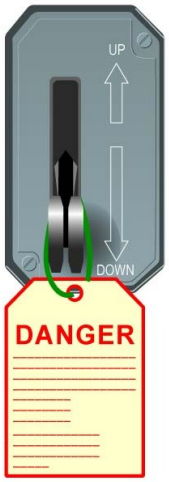
...

CAUTION: YOU MUST CLOSE THE MLG DOORS BEFORE YOU DEFLATE THE MLG SHOCK ABSORBER. IF THE DOORS STAY OPEN, THEY WILL HIT THE GROUND AND DAMAGE WILL OCCUR.

CAUTION



SAFETY DEVICE



L/G LEVER (312VU)

MLG GROUND DOOR OPENING HANDLE

GREEN HYD. SYSTEM (DEPRESSURIZED)

HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

...

Procedure

...

Hydraulic replenishment of the MLG shock absorber

- Open bleed screw. Install the 3-way valve, the bleed tube and the container.
- Check the pressure control valve is closed.
  Open bleed/inflation valve. wait 2 hours. Close the bleed screw.
- Connect hydraulic source. Connect the secondary bleed valve.
- Bleed the fluid at 1.7 bars until 5 liters of free air fluid has flown.

...

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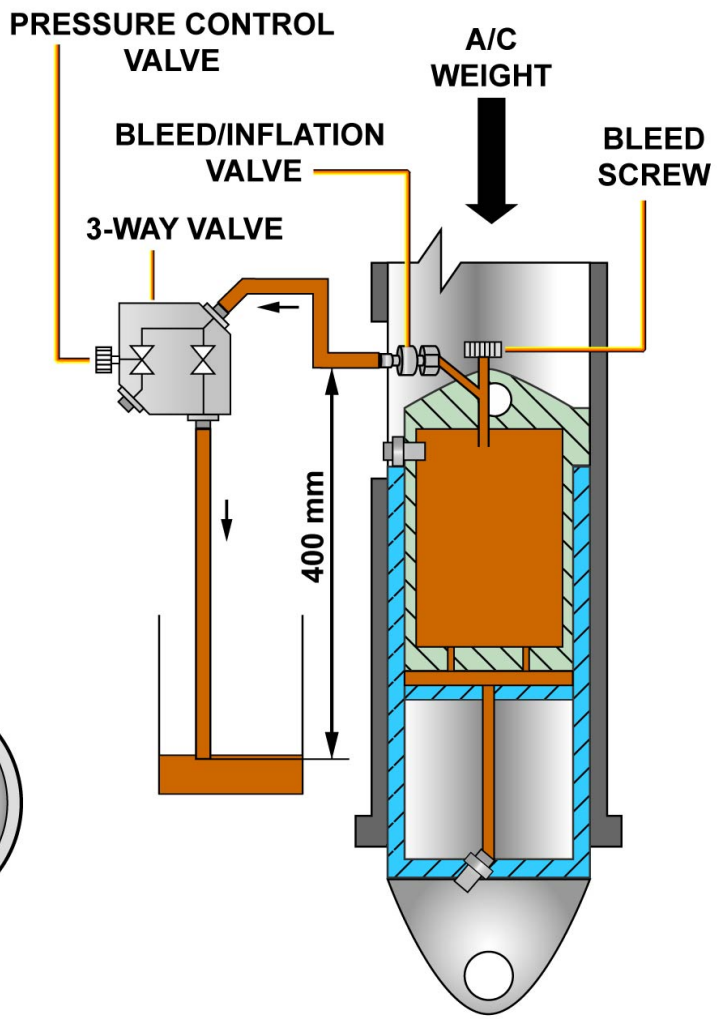

HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

...

Procedure

...

Hydraulic replenishment of the MLG shock absorber

- Check the pressure control valve is closed. Open bleed/inflation valve. wait 2 hours. Close the bleed screw.
- Connect hydraulic source. Connect the secondary bleed valve.
- Bleed the fluid at 1.7 bars until 5 liters of free air fluid has flown.
- Close the valves when fluid is free from air.

...

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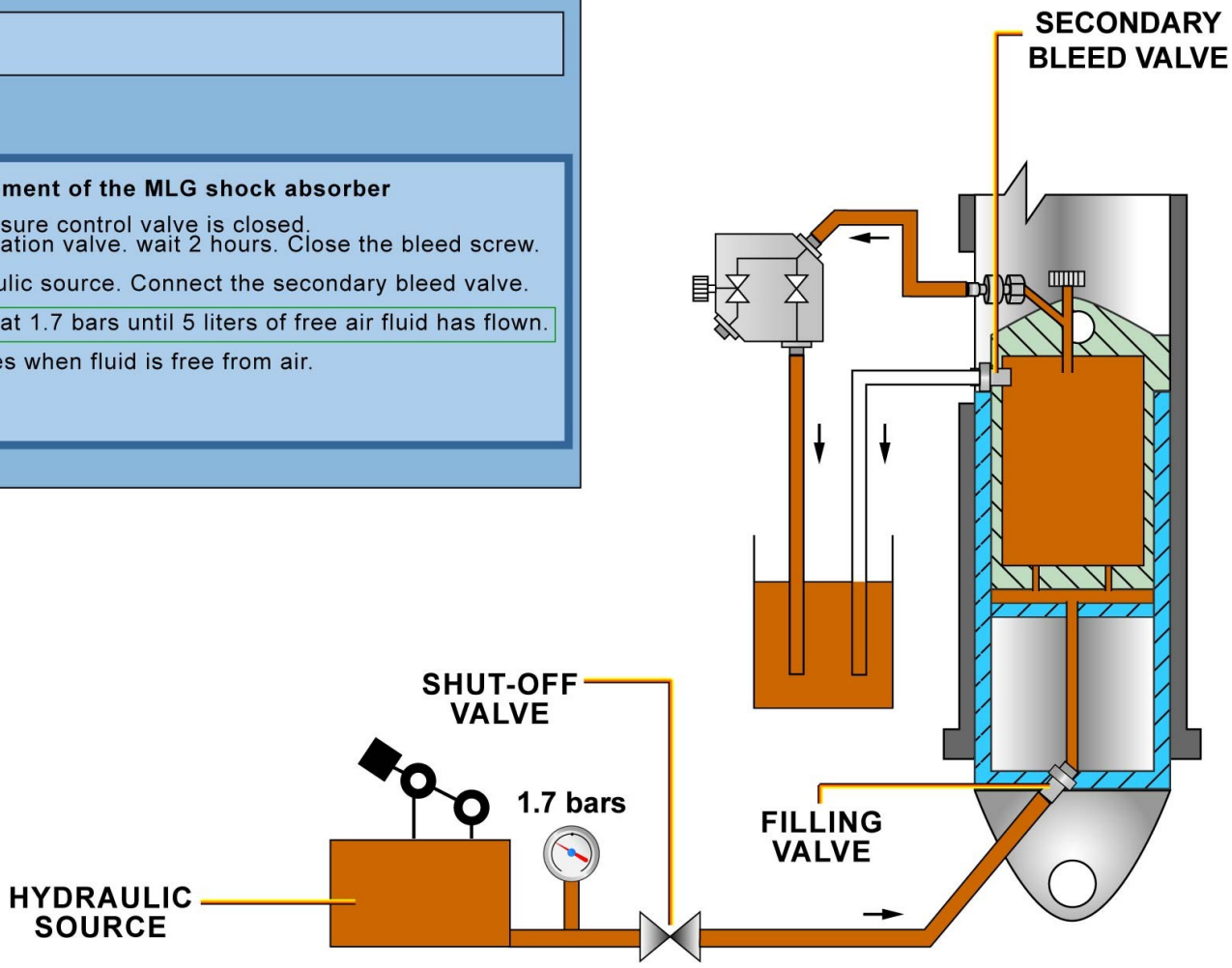
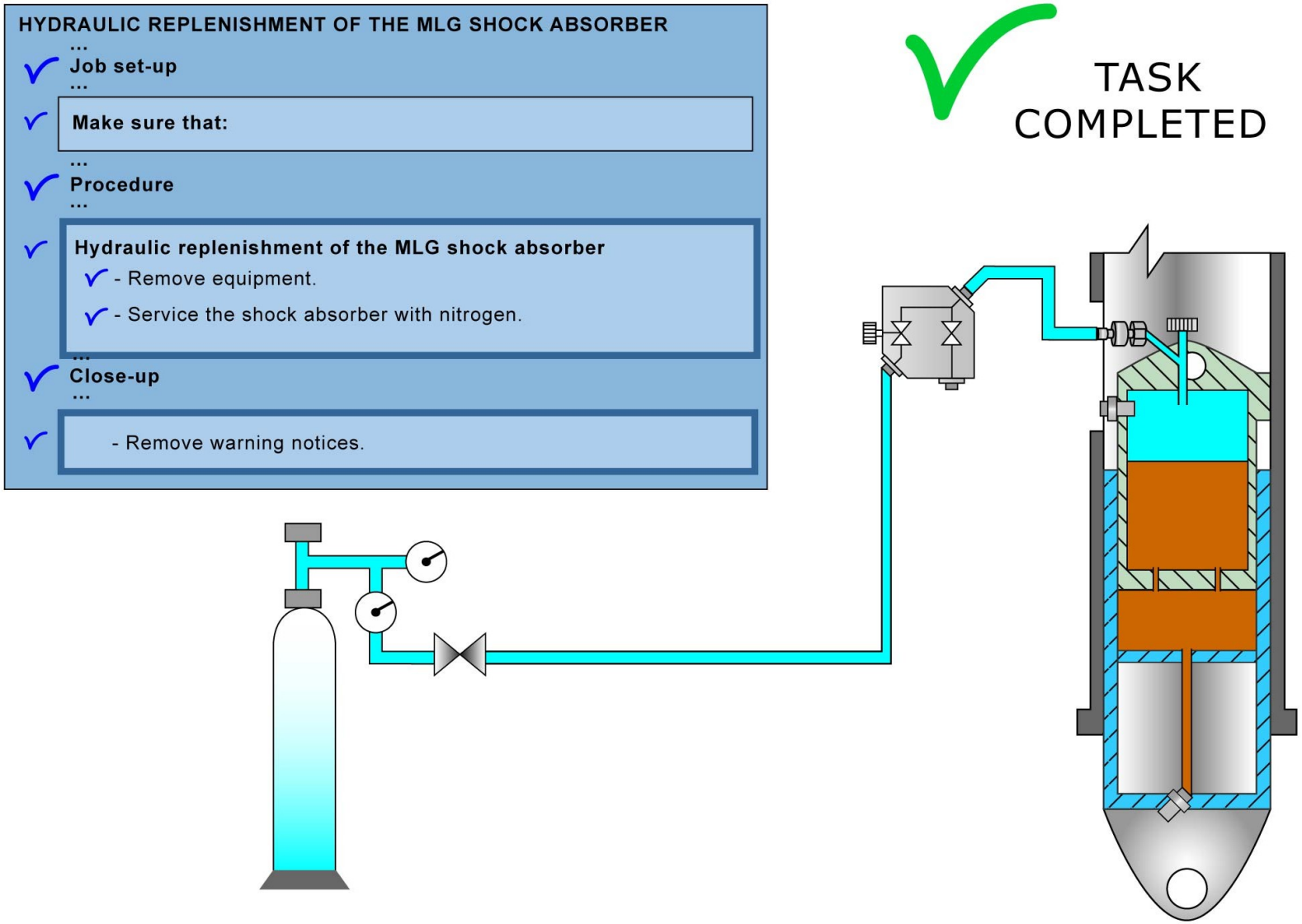


HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

G9409341 - GAUT0T0 - FM32Y2BASEMCE03



HYDRAULIC REPLENISHMENT OF THE MLG SHOCK ABSORBER

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G9409341 - GAUT0T0 - FM32Y2BASEMCE03

LANDING GEAR SYSTEM BASE MAINTENANCE (3)

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER (A/C ON JACKS)

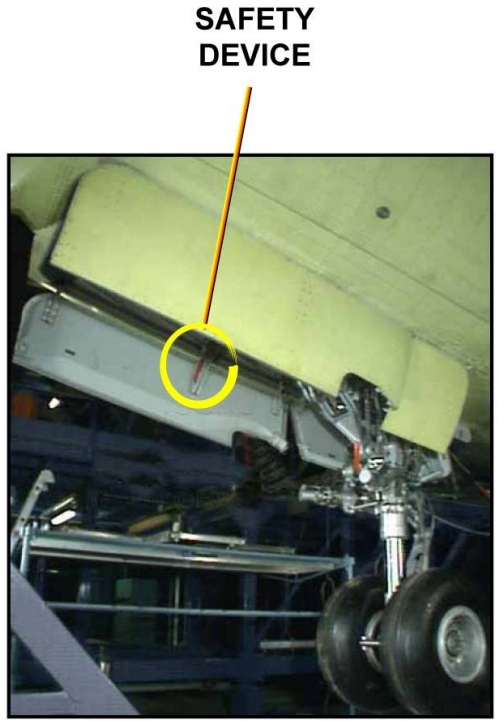
Put warning notices in the cockpit to tell personnel not to operate the L/G control.
Make sure that the green hydraulic system is depressurized.
Make sure that the safety devices are installed on the NLG. Open the NLG doors and install the safety devices.

NOTE: Note: Make sure that the A/C is on jacks and that the wheels of the NLG are clear on the ground.

Open the bottom chamber charging valve to depressurize the High Pressure (HP) chamber. Open the top chamber charging valve to depressurize the LP chamber.
Close the bleed control valve and leave the top chamber charging valve open. Slowly fill the LP chamber with fluid pressurized to 15 bar maximum. Depressurize the top chamber charging valve and leave it open.
Install a filling assembly on the bottom chamber charging valve to connect the nitrogen filling hose and the nitrogen supply hose. Slowly pressurize the HP chamber with nitrogen up to the correct pressure. Close the bottom chamber charging valve, remove the filling assembly and disconnect the nitrogen filling hose. Make sure that LP chamber is full of hydraulic fluid.
Slowly operate the axle jack to push the sliding tube fully into the main fitting. Redo the procedure consisting in pressurize fluid at 15 bar maximum and let the sliding tube fully extend. Redo this procedure until there is no air remaining in the hydraulic fluid.
Operate the axle jack till H is between 189 mm and 194 mm. Connect the nitrogen filling hose to the top chamber charging valve to connect the nitrogen supply hose. Slowly pressurize the LP chamber with nitrogen and open the valve on the axle jack, in a controlled manner, to let the shock absorber fully extended. Pressurize the nitrogen to the correct pressure and make sure that H is between 408 mm and 416 mm.
Remove the access platform and make sure that the work area is clean and clear of tools and other items. Lower the aircraft off jacks. Do a pressure/extension check of the NLG shock absorber.
Remove the safety devices from the NLG doors and close the NLG FWD doors. Remove all the fixtures, tools, test and support equipment used during this procedure.

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER
...
Job set-up
...
Make sure that:
- Warning notices are put in the cockpit.
- Green system is depressurized.
- Safety devices are installed on NLG and NLG doors.
...
Procedure
...
Hydraulic replenishment of the NLG shock absorber
...
Close-up
...



L/G
LEVER
(312VU)

GREEN HYD. SYSTEM (DEPRESSURIZED)

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER (A/C ON JACKS)

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

...

Procedure

...

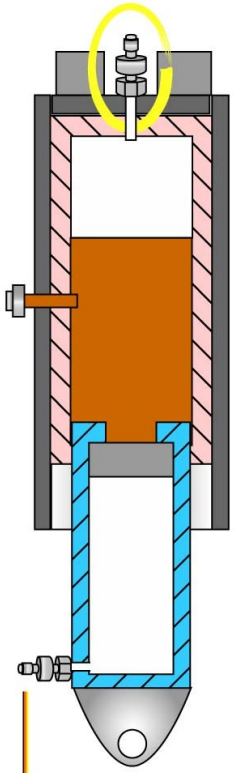
Hydraulic replenishment of the NLG shock absorber

- Depressurize both chambers.
- Pressurize fluid at 15 bars maximum.
- Fill LP chamber with fluid.
- Hydraulic fluid free from air.

...

...

TOP CHAMBER CHARGING VALVE



BOTTOM CHAMBER CHARGING VALVE

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER (A/C ON JACKS)

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

Job set-up

...

Make sure that:

...

Procedure

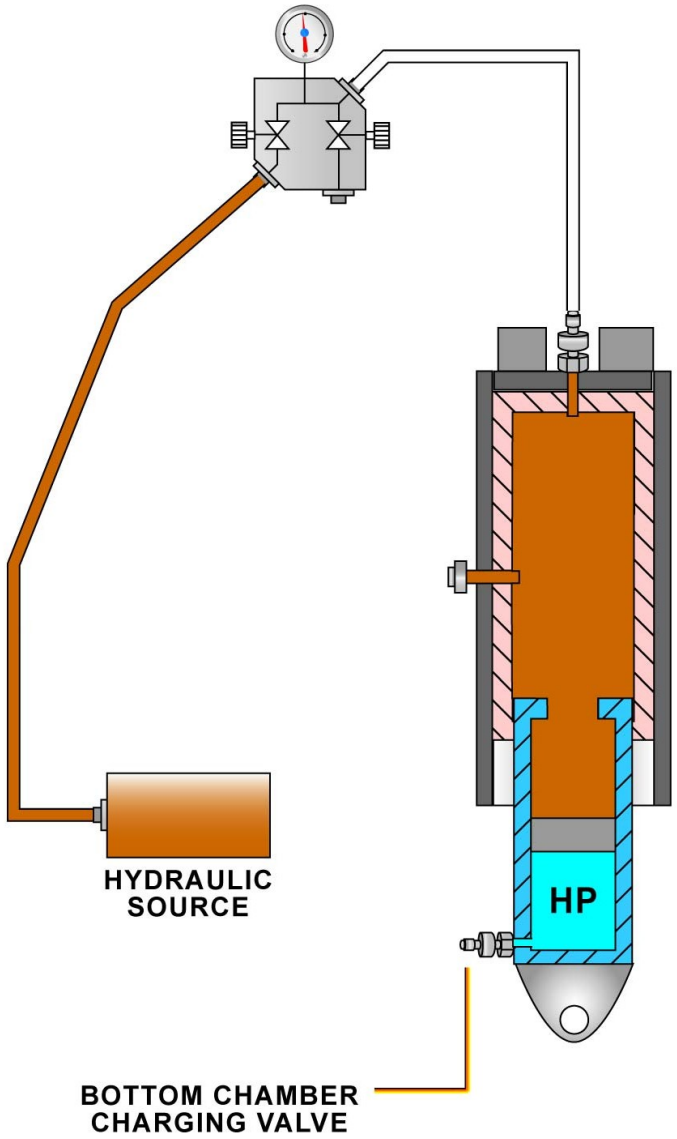
...

Hydraulic replenishment of the NLG shock absorber

- Depressurize both chambers.
- Pressurize fluid at 15 bars maximum.
- Fill LP chamber with fluid.
- Hydraulic fluid free from air.

...

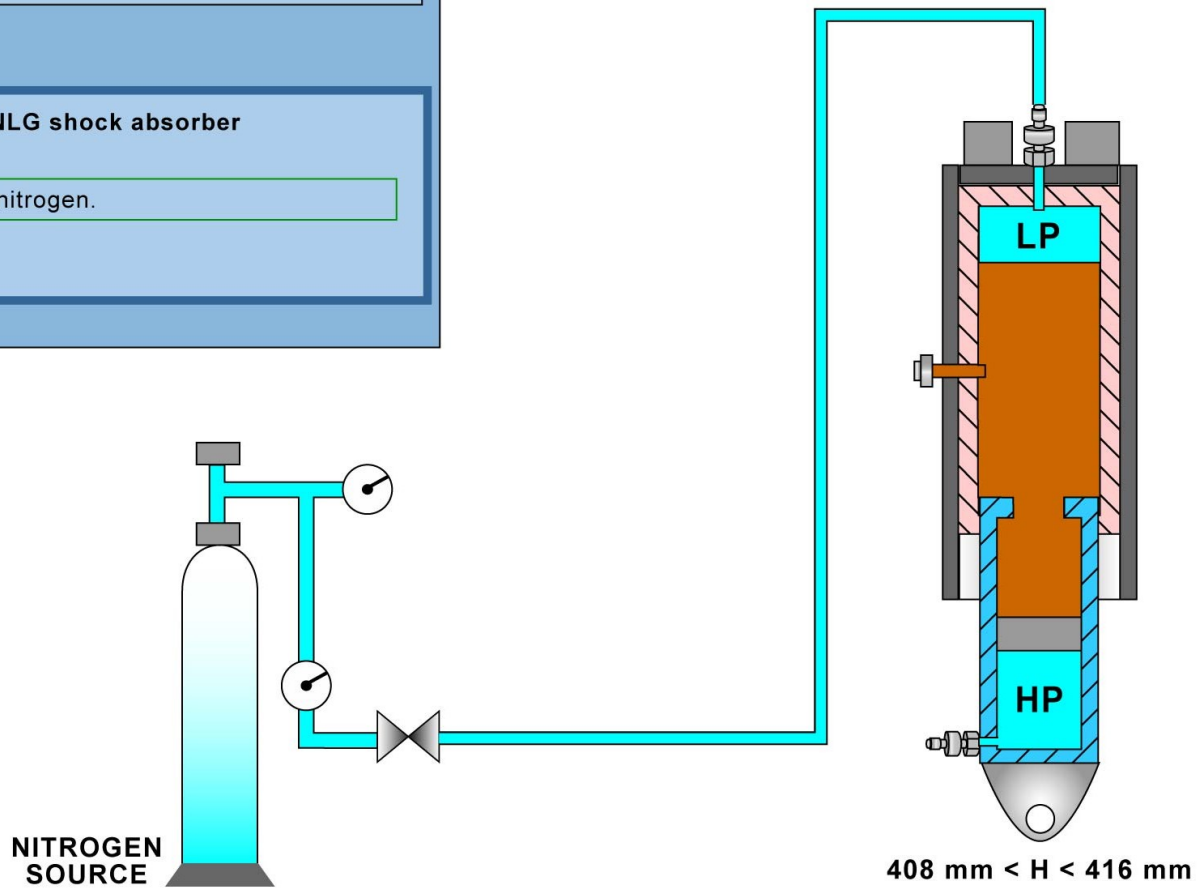
...



HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER (A/C ON JACKS)

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER
...
Job set-up
...
Make sure that:
...
Procedure
...
Hydraulic replenishment of the NLG shock absorber
- ...
- Pressurize LP chamber with nitrogen.
- Pressure / extension check.
- ...
...



HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER (A/C ON JACKS)

G9409341 - GAUT0T0 - FM32Y2BASEMCE03

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER

...

✓ Job set-up

...

✓ Make sure that:

...

✓ Procedure

...

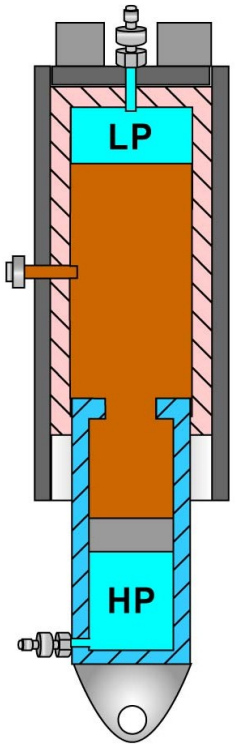
✓ Hydraulic replenishment of the NLG shock absorber

...

✓ Close-up

...

✓ - Remove warning notices and safety devices.



✓ TASK COMPLETED

HYDRAULIC REPLENISHMENT OF THE NLG SHOCK ABSORBER (A/C ON JACKS)

AIRBUS

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